IS-37

THE MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS' MISSOURI RIVER WATER RESERVATION REQUEST IS IN THE PUBLIC INTEREST

Suggested Format and Arguments To Address
ARM 36.16.105 C(1)(a),(b) and (c)

Prepared By

Ken Knudson
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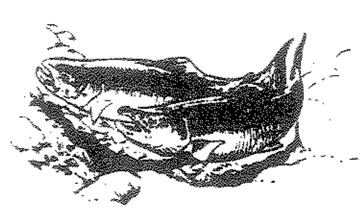
April 10, 1989



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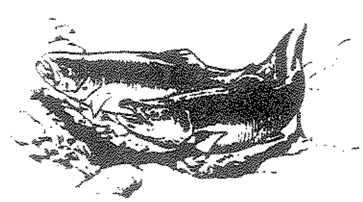

PREFACE

The following information was taken primarily from two earlier reports prepared for the Department of Fish, Wildlife and Parks - "Information For the Public Interest Portion of the Missouri River Water Application" (Ken Knudson; July 31, 1988) and "The Direct and Indirect Benefits and Costs of Granting a Water Reservation for In-Stream Flows in the Missouri River Basin" (Joe Elliot; January, 1989).

With suggestions from Mr. Elliot and Liter Spence of the Department, Mr. Knudson combined and edited the above reports into the format that follows. He also prepared most of the narrative for the Direct and Indirect Benefits sections, as well as the discussion covering the effects of not granting the reservation.

Mr. Elliot prepared some of recreational use data found in the Direct Benefits section. He also researched and wrote most of the material addressing indirect economic costs, as well as some of the material for indirect economic benefits of the reservation.

Liter Spence provided invaluable guidance and editing throughout the preparation of this document. Fred Nelson, Dick Vincent and Steve Leathe of the Department provided editorial suggestions for the Direct Benefits section.

Both authors have listed all written information sources, as well as all persons verbally contacted for additional or clarifying information, in the Literature Cited section.

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I. Direct Benefits and Costs of the Reservation

The following is pursuant to ARM 36.16.105 c(1)(a) of the Water Reservation Rules, e.g. "In making a showing that the reservation is in the public interest, the application shall contain . . . an analysis of the direct benefits and costs associated with applying reserved water to the proposed beneficial use." Direct benefits and costs are defined at ARM 36.16.102 (6) and (7) as "benefits and costs to the reservant derived from applying reserved water to the use for which it is granted." The following, therefore, describes the public benefits and costs of the reservation as they apply to the stream-based recreational resources managed by the Department of Fish, Wildlife and Parks on the portions of the Missouri River included in this reservation request.

A. Direct Benefits

1. Fisheries and Fishing Opportunities

Interest and utilization of public fishing resources in Montana continue to increase, despite the state's stable (or at times declining) population over the past two decades. In 1966, 159,466 resident fishing licenses were sold. By 1976 these sales had increased to 170,000. In 1986, despite reports of recent wide-spread emigration from the state, 183,291 resident fishing licenses were sold (Herman 1988).

Data from the Sport Fishing Institute indicate that Montana is also highly valued for its fishery resource by people from outside the state. In 1987, Montana ranked fourth in the nation for the number of non-resident fishing licenses sold. Despite being relatively isolated from major population centers, Montana attracts a disproportionately large number of nonresident anglers because of its unique and productive fisheries resource. The opinions of these visitors reflect the quality of fishing in Montana; 91.3 percent of surveyed non-resident anglers reported

Montana to have good or excellent angling opportunities (Brock et al. 1984).

The national significance of Montana trout streams was also brought clearly into focus in the spring, 1989, issue of Trout - The Magazine for Trout and Salmon Anglers. The feature article of this issue, a special publication commemorating the thirtieth anniversary of the magazine, was "America's 100 Best Trout Streams" (Alexander, et al. 1989). Of these nationally-acclaimed fishing streams, 12 are in Montana, which is the highest total of any state in the nation. Alaska ranks second to Montana with 11 listed streams, followed by Idaho (9), New York (6), and Wyoming (6). It is significant to note that 6 of America's best 100 trout streams, i.e. the Beaverhead, Big Hole, Gallatin, Madison, Missouri, and Smith rivers, are in the portion of the Missouri Basin covered by this reservation request.

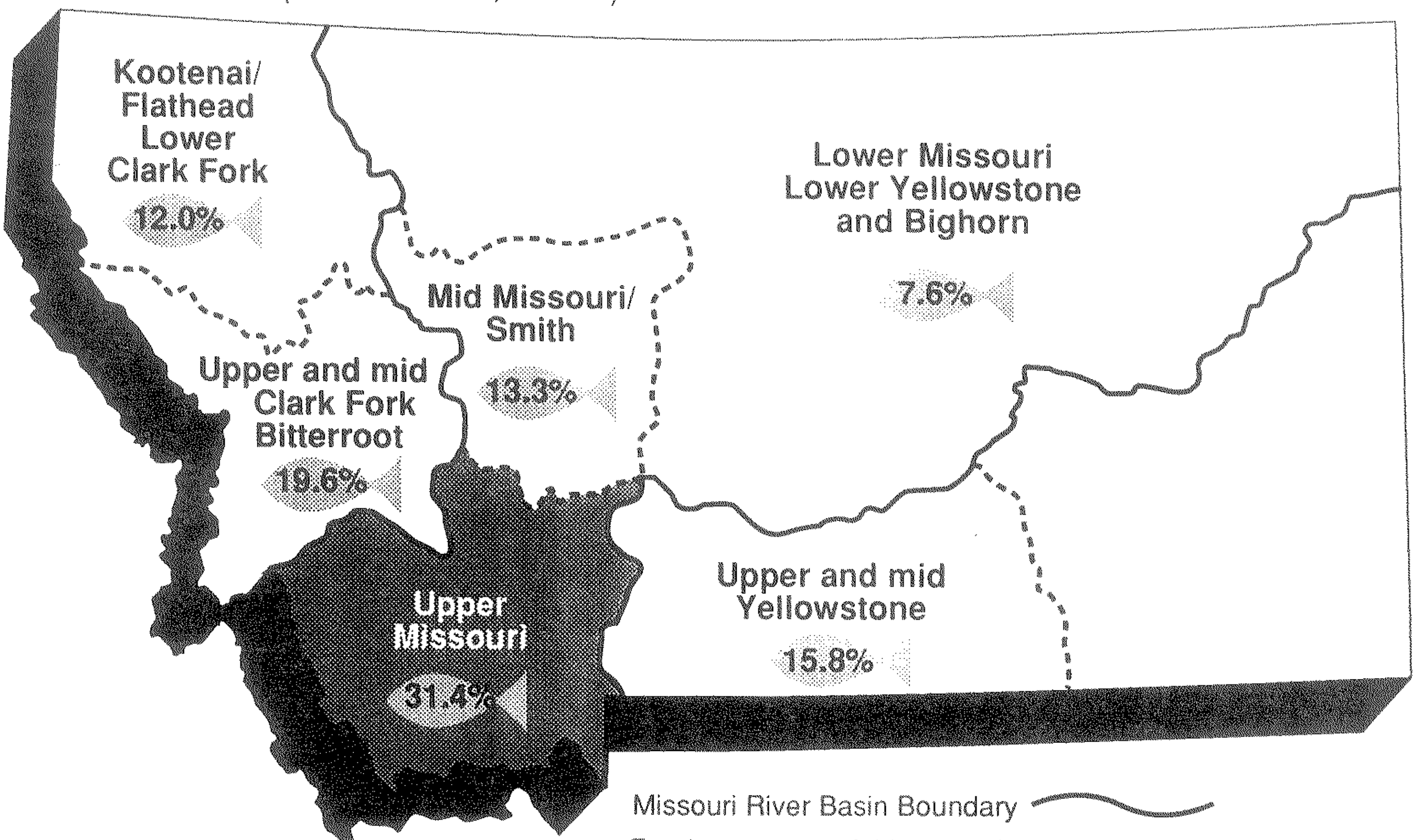
Even though fishing represents only one of many stream-related recreational activities, it can serve as a valuable indicator of overall recreational use. Based upon questionnaires sent to fishing license holders, the DFWP annually estimates the fishing pressure (angler use) of streams in Montana. During May through October, 1985, the Department increased the intensity of this angler survey by doubling the number of questionnaires normally mailed (McFarland 1988). The results of this research emphasized the exemplary stream-based, public recreational benefits of the upper Missouri River.

The rivers and streams of the Missouri above Canyon Ferry Reservoir accounted for 375,239 of the total 1,193,000 days spent stream fishing in Montana during 1985. Despite being less than 10% of the geographic area of Montana, the upper Missouri supported 31.4% of the state's stream fishing. As is illustrated in Figure 1, no other geographic area of similar or even larger size supported nearly as high a percentage of total stream fishing in Montana. Angler use of streams in the upper Missouri Basin during 1985 is tabulated in Table 1.

The fact that hundreds of thousands of people annually fish the upper Missouri Basin is testimony to the exceptional wild (naturally-reproducing) trout fishery that is found there. Very high angler success rates for wild brown and rainbow trout have made the Madison one of the most popular rivers in North America. Some reaches of the Madison contain over 3,500 catchable trout per mile. The salmonfly hatches of the Madison, Big Hole and Gallatin rivers are legendary, attracting a following of anglers who annually chase "the hatch" from river to river. Due to its relatively undeveloped watershed, the Big Hole is one of the largest trout streams outside of designated national wilderness areas that remains essentially non-turbid during runoff. This river is also home to the last major population of river-dwelling arctic grayling in the lower forty-eight states. The Gallatin River is another nationally-acclaimed trout stream, offering a wide variety of fishing experiences--from swift-gradient, mountain canyons to slow-moving, broad valley sections.

Figure 1. Fishing Use of Montana River Basins, 1985

Values are the percentage of total, state-wide fishing days occuring in each river basin, and were computed from information collected during the 1985 DFWP fisheries survey (McFarland, 1988).



For the purpose of this map, the mid Missouri is the mainstem from Canyon Ferry Reservoir to the mouth of the Marias River.

TABLE 1

ANGLER USE OF STREAMS
IN THE UPPER MISSOURI RIVER BASIN DURING 1985

Stream	Annual Angler Days
Beaverhead River	24,239
Big Hole River	47,910
East Gallatin River	6,191
Gallatin River	63,871
Madison River	108,712
Jefferson River and Tributaries	29,129
Upper Missouri River and Tributaries above Canyon Ferry Dam	25,419
Madison River Tributaries	11,224
Gallatin and East Gallatin River Tributaries	14,045
Beaverhead River Tributaries (includes Ruby and Red Rock rivers and tributaries)	25,878
Big Hole River Tributaries	18,621
Total	375,239

State Total 1,193,000 days

Percent of State Total 31.4%

Source: McFarland 1988.

The Madison, Big Hole and Gallatin rivers, while certainly exceptional fishing streams on a national scale, are really not that unusual in the trout-rich upper Missouri Basin. Along with these three rivers, the Missouri mainstem from Toston Dam to Canyon Ferry Reservoir and the Beaverhead River are also rated by the Department of Fish, Wildlife and Parks as Class One, "blue ribbon" trout streams. This distinction has been given to only a select number of streams in Montana that are considered to have "the highest valued fishery resource" in the state. The Ruby, East Gallatin, Jefferson, and Red Rock rivers are also very important trout streams, as are many tributaries of the basin's major rivers. The latter not only serve as vital spawning streams for the larger rivers, but also often contain an abundance of resident trout. These smaller trout streams provide heavily-utilized backcountry stream fishing opportunities. For example, the Big Hole River tributaries which received 18,624 days of angler use in 1985, support significant fisheries for rainbow, brook and cutthroat trout as well as arctic grayling.

Below the confluence of the Madison, Jefferson and Gallatin rivers, the mainstem of the Missouri and numerous tributaries continue to provide additional high-quality trout fishing opportunities. The river above Canyon Ferry Reservoir not only contains resident populations of rainbow and brown trout, it also supports heavily-fished spawning migrations of trout from the reservoir; these migrants are the primary reason for the "blue ribbon" rating of the River between Toston Dam and Canyon Ferry.

The six mile stretch of free-flowing river between Hauser Dam and Holter Reservoir is also a significant fishery for migrant trout and Kokanee salmon.

Fish migrations from other reservoirs and lakes provide many important stream fishing opportunities throughout the basin. In fact, all tributaries to reservoirs or lakes that contain a trout fishery will support spawning runs, but only if adequate habitat, water quality and instream flows exist in these feeder streams.

These spawning runs also help sustain the trout populations of reservoirs and lakes. Although many of these water bodies are routinely stocked with hatchery fish, successful runs of wild trout augment, and in some cases exceed, the contribution of planted fish. For example, in Hebgen and Harrison reservoirs, maintenance of trout populations is highly dependent upon natural reproduction. As well, reservoir-dwelling brook and brown trout rely on streams and/or spring areas for their reproductive needs, since hatchery plants of these species have essentially been discontinued in Montana during recent years.

The benefits of adequate instream flows therefore extend beyond flowing waters to include reservoirs and lakes. These waterbodies support a significant amount of recreational fishing. In 1985, reservoirs and lakes in the Missouri Basin above Holter Dam supported 322,661 angler days; in the basin below Holter Dam to Fort Peck Reservoir, these waterbodies supported 160,704 angler days (McFarland 1988). Combining these figures demonstrates that the portion of the Missouri Basin covered by the reservation request supported 483,365 days of reservoir and lakes fishing, which was 44.7 percent of the statewide total (Op.Cit.).

During 1985, the Missouri River from Holter Dam to Cascade sustained over six percent of all stream fishing in Montana (72,788 angler days). Since this high amount of usage occurred along only 35 miles of river, this reach of the Missouri received more recreational fishing per mile than any other stream in Montana. The Madison, for example, also received heavy use (108,712 angler days, the highest total use of any stream), but it was dispersed along more than 80 miles of river. Rainbow trout comprise the bulk of the fishery in the Holter Dam to Cascade reach, although trophy-sized brown trout, some as large as 15-20 pounds, are also occasionally taken by anglers.

From Cascade to its confluence with the Sun River near Great Falls, the Missouri continues to support a respectable trout fishery. Some trout are even found as far downstream as the confluence with the Marias River below Fort Benton.

The Smith River, which enters the Missouri just above Great Falls, is also an important trout stream. Although relatively small and inaccessible, it sustained 11,824 fishing days in 1985.

There are also other streams in the Missouri Basin that contain significant, locally-important trout populations. The upper Judith and Musselshell rivers, Big Spring Creek near Lewistown, and the twenty-mile reach of the Marias below Tiber Dam, provide quality trout fishing for residents of Lewistown, Harlowton, Chester and other nearby communities. In fact, for its size, Big Spring Creek is an exceptional rainbow and brown trout fishery, with population estimates approaching 3,000 catchable trout per mile (Leathe and Hill 1987). Without adequate instream flow protection for these and other tributaries of the lower Missouri, many residents of north-central Montana would have to travel several hours to obtain suitable alternatives for stream fishing.

From Morony Dam below Great Falls to Fort Peck Reservoir, the Missouri River and its tributaries support a warm water fishery of national, if not international, significance. Although it presently receives a relatively small amount of angler use (see Table 2 for angler use data of all streams in the lower Missouri), this 207-mile, free-flowing reach does contain an exceptionally diverse, unique and presently under-utilized fishery.

Of the 18 families and 80 species of fish reported to be found in Montana (Brown 1971), 14 families and 53 species are found in this reach and/or its tributaries. Of Montana's 52 native fish species, 35 can be found in the lower Missouri Basin (Berg 1981).

The paddlefish population of the lower Missouri/Fort Peck Reservoir system is of particular importance. Paddlefish are Montana's largest gamefish, with female specimens often reaching five to six feet in length and weighing 75 to 125 pounds. Once abundant during the Triassic Period 150 million years ago, these

TABLE 2

ANGLER USE OF STREAMS IN
THE LOWER MISSOURI RIVER BASIN DURING 1985

Stream	Annual Angler Days
Missouri River and Tributaries (between Marias River and Fort Peck Dam)	22,340
Missouri River (Canyon Ferry to Marias River; excluding Holter to Cascade)	67,557
Missouri River (Holter to Cascade)	72,788
Marias River	5,925
Musselshell River	11,218
Smith River	11,824
Smith River Tributaries	7,143
Total	198,795

State Total 1,193,000 days

Percent of State Total 16.7%

Source: McFarland 1988.

very primitive fish are presently found in only two river basins--the Yangtze in China and the Mississippi/Missouri system (Hubbs and Lagler 1967; Romer 1962). Even in these basins, the distribution and abundance of paddlefish have been dramatically reduced during the past 100 years (Pflieger 1975; Yasetskiy 1971). Although "spoonbill cats" once supported a significant commercial fishery, particularly along the Mississippi, stream channelization, dams, over-harvesting, and alteration of stream flows have reduced the range of paddlefish in the United States to only six isolated, self-sustaining populations.

Growth rates of paddlefish in the lower Missouri/Fort Peck system are superior to the other five remaining Mississippi/ Missouri populations; the lower Missouri population is also older (in terms of average age of fish) and more secure than anywhere else in North America (Berg 1981). This security and biological success is largely due to the unaltered, free-flowing characteristics of this reach of river, which provides essential and irreplaceable spawning areas for paddlefish. Berg (1981) identified nine critical paddlefish spawning sites in the lower river from just below the confluence of the Marias River to just above Fort Peck Reservoir.

The relatively undeveloped characteristics of the lower Missouri also provide the most secure unaltered habitat remaining in the Mississippi/Missouri Basin for two other relics of the dinosaur era--the pallid and shovelnose sturgeons. Sitings of the pallid sturgeon have been rare over the past few decades

(Brown 1971; Holton 1981). Only one pallid sturgeon was captured in the lower Missouri during electrofishing studies conducted by the DFWP 1975-1980. Because of its presently rare occurrence, the U. S. Fish and Wildlife Service is considering listing the pallid sturgeon as an endangered species.

The shovelnose sturgeon population of the lower Missouri River is healthy and vigorous. Fish of this species residing in the Missouri above Fort Peck Reservoir are much larger than those found in the Missouri River in South Dakota, the Mississippi River in Iowa or the Chippewa River in Wisconsin. In these midwestern rivers, shovelnose sturgeon rarely exceeded 5 to 7 pounds, whereas several collected in the river system above Fort Peck have weighed over 10 pounds. In fact, the average weight and length of shovelnose from this Montana river reach, equalled or exceeded the maximum size of those from the South Dakota, Iowa and Wisconsin rivers (Berg 1981).

Significant sport populations of sauger and channel catfish are also found in the lower Missouri above Fort Peck. Growth of channel catfish in this river reach is equivalent or superior to growth in other northern waters; it also compares favorably with growth of this species in lakes and rivers of southern states (Op.Cit.). Channel catfish, sauger and shovelnose sturgeon all utilize the free flowing lower Missouri, as well as the lower Marias and Judith rivers for spawning. The lower Missouri also supports spawning runs of goldeye, bigmouth buffalo and smallmouth buffalo, which contribute to the commercial fishery in Fort Peck Reservoir.

Data for the lower Missouri river indicate relatively light harvest rates for all fish species. For example, only 0.5 percent of shovelnose sturgeon that were tagged by biologists were returned by anglers, compared to a 2.3 percent return in the Red Cedar/Chippewa River system in Wisconsin (Berg 1981). Priegel (1973), in studies on the Menominee River in Wisconsin, felt that sturgeon populations can sustain harvest rates of up to 5.0 percent without harm.

Cumulative paddlefish harvest rates in the lower Missouri are also low compared to other waters. Only 7.0 percent of the fish tagged during 1972-1977 were returned by anglers. This compares to a 13.8 percent return rate during 1964-1975 on the lower Yellowstone in Montana (Elser 1976), and a 24.5 percent rate of return during three years of tagging studies on the Osage River, Missouri (Purkett 1963). (This latter population no longer exists; paddlefish spawning sites on the free-flowing Osage River were eliminated by the reservoir behind Truman Dam in 1978.)

The above data, along with tag-return information for channel catfish and sauger, indicate that the lower Missouri is an under-utilized recreational fishing resource. Opportunities for steady growth in the recreational use of the lower Missouri is, therefore, very good. Protection of adequate instream flows will allow this potential to materialize.

2. Floating

Rivers and streams in Montana provide exceptional recreational benefits to a broad spectrum of the public. Fifty-six percent of all Montanans fish and over thirty percent float in rafts, canoes or kayaks (Frost and McCool 1986).

A study conducted by the University of Montana (Op.Cit.) documented that the Missouri River Basin is extensively used for water-based recreation by Montanans and out-of-state visitors. These researchers reported that about 35 percent of river floaters considered rivers in the Missouri River drainage to be their favorite Montana streams to float. The Montana stream most cited by floaters was the Yellowstone River (19.7 percent) followed by the mainstem of the Missouri (11.2 percent) and the Madison River (3.8 percent).

The Smith River is also very popular with floaters. Although agricultural water diversions usually restrict floating opportunities after mid-July, an average of 1,714 people floated the Smith during 1984-1986 (Table 3). Floating the Smith usually takes several days. Because of these multi-day floats, the Smith actually supported about 7,000 floating days per year from 1984-1986.

The Smith is the only river in the Missouri Basin above Fort Benton where floating use has been extensively evaluated. But, this is not to say that the Missouri and its tributaries are not extensively used, and popular, for floating. Nearly half of the

TABLE 3

NUMBER OF FLOATERS USING THE SMITH RIVER

Month/Week	1987	1986	1984	Total
May				
Week 1	52	79	35	166
Week 2	63	15	35	113
Week 3	118	55	93	266
Week 4	260	264	45	569
June				
Week 1	119	167	50	336
Week 2	183	233	147	563
Week 3	140	240	349	729
Week 4	58	380	413	851
July				
Week 1	10	114	502	626
Week 2	55	142	119	316
Week 3	57	114	32	203
Week 4	57	47	33	137
August				
Week 1	28	42	34	104
Week 2	7	31	18	56
Week 3	10	14	24	48
Week 4	23	34	3	60
Total	1,240	1,971	1,932	5,143

Source: Montana Department of Fish, Wildlife and Parks (1988).

pages of a popular Montana floating guide (Fisher 1979) are devoted to float trips in the Missouri Basin. From the spectacular canyons of the Dearborn, Smith and Gallatin rivers to the meandering solitude of the Marias, Red Rock and lower Missouri rivers, the basin abounds with floating opportunities.

The lower Missouri River from Fort Benton to Fort Peck Reservoir not only supports a unique, diverse and productive fish community, it is also the largest unaltered, free-flowing and relatively uninhabited segment of the nation's longest river. For 149 miles the river winds through spectacular breaks, cliffs and badlands within a gorge several hundred feet below the Great Plains. There are no channel pilings, flood walls, rock and concrete flow deflectors, dams, reservoirs or large irrigation structures that typify the "Mighty Mo" as it sluggishly travels from Fort Peck to its confuence with the Mississippi River. Only from Fort Benton to Fort Peck does the Missouri remain as it existed for prairie-dwelling Native Americans, Lewis and Clark, and the steamboats that vanguarded the first major immigration of white people into Montana during the last century. The number of modern-day adventurers that retrace this historic river route is significant. The Bureau of Land Mangement (U. S. Department of the Interior 1988) reported that 66,585 visitors enjoyed 75,582 visitor days annually along the Missouri between Fort Benton and the Fred Robinson Bridge, which is located just above Fort Peck Reservoir.

Congress, in recognition of the extraordinary biological, recreational, scenic and historical values found along this 149 miles of river, officially designated this reach as a National Wild and Scenic River in 1976. Although this designation does allow minor diversion and pumping of water for agricultural purposes, no dams are allowed and specific protection measures must be taken before any large-scale human-development can occur.

3. Other Benefits

The stream discharge rates requested in this application will not only benefit the fishing and floating recreational resources of the Missouri Basin, but they will also be vital for maintaining the health and vigor of stream-side (riparian) vegetation. The often shallow-rooted, water-loving plants found in riparian areas depend upon adequate instream flows to recharge shallow, stream-side aquifers.

Riparian areas contain highly diverse plant, songbird and small mammal populations. They are also the most productive wildlife areas in North America and are utilized extensively by big game, furbearers and waterfowl. The biological abundance and diversity found within riparian areas also adds to the number and kinds of people who recreate along streams; i.e. photographers, bird-watchers, science students, hunters, berry-pickers, naturalists, etc.

* * * * *

From its blue ribbon headwaters to its wild and scenic lower reaches, the Missouri and its tributaries are enormous recreational and aesthetic assets for the people of Montana and the nation. As will be discussed in the Indirect Benefits section of this application, the free-flowing Missouri River system also provides a substantial economic base for the people of Montana. In order to protect and provide the opportunity to enhance these direct public benefits, it is essential that the instream flows requested in this application be granted.

B. Direct Costs of the Reservation

Some stream reaches of the Missouri River Basin do not have gages at appropriate locations to adequately monitor streamflows. Once reservations are granted, monitoring of streamflow on the stream reaches may be necessary for protection of the granted flows. Costs of installing gages would range from $600 to $17,500 per gage, depending on the level of technology required for adequate monitoring (Karp 1987). Annual operating costs would range from $800 to $5,500, depending on the complexity of the monitoring program (Karp 1987).

The only other direct costs are those for DFWP operations to implement whatever program is required to protect the granted reservations. Specific information and costs cannot be given at this time.

II. Indirect Benefits and Costs of the Reservation

Indirect benefits and costs, as defined in ARM 36.16.102 (12) and (13), mean the benefits and costs of applying reserved water to beneficial use that accrue to other uses or to parties other than the reservant. For the purpose of this application "indirect," therefore, refers to "uses or parties other than" the DFWP; and the DFWP reservation will be the means "of applying reserved water to beneficial use."

ARM 36.16.105 C(1)(b) requires that all applications for reserved water include a discussion of the benefits and costs (to other uses or parties) associated with (the reservation) that considers effects on (i) future economic activity, (ii) the environment, (iii) public health and safety, and (iv) the economic opportunity costs that the requested flow may have to parties other than the reservant.

The economic considerations of these requirements, subsections (i) and (iv) are discussed below in **A. Effects of the Reservation on Future Economic Activity,** and in **C. Economic Opportunity Costs of the Reservation.** The indirect economic **benefits** of the reservation are covered in A., while indirect economic **costs**, including foregone opportunity costs, are addressed in C. Non-economic considerations, as per sections (ii) and (iii) above, are presented in **B. Effects of the Reservation on the Environment, Public Health, Welfare and Safety.**

When establishing and prioritizing water reservation requests, a major criterion utilized by the Board of Natural Resources and Conservation is an evaluation of the effects that a reservation may have upon "other uses or parties." The following discussion, therefore, presents the overall indirect benefits and costs of the MDFWP reservation as well as its specific effects upon municipal, agricultural and industrial users.

A. Effects of the Reservation on Future Economic Activity

1. An Overview of Indirect Economic Benefits

The instream flows requested in this application are necessary to protect the direct recreational and aesthetic benefits provided by the rivers and streams of the Missouri Basin. Protection of these amenities also significantly contributes to the economic well-being of Montana.

Tourism, one of the fastest growing segments of Montana's economy, is directly related to the amenities of the state's natural environment, particularly those provided by rivers and streams. In 1986, nearly 2.8 million non-residents visited Montana, generating over $475,000,000 in income for the state (Montana Department of Commerce 1988).

Most major highways in Montana closely parallel rivers and streams. It is along these waterways that visitors gather many of their lasting impressions of the state. According to a survey of tourism in Montana conducted by Montana State University (Brock et al. 1984), 95.4 percent of non-residents surveyed perceived Montana as good or excellent in terms of the state's outdoor recreation amenities. Maintaining the instream flows requested in this application will help protect the outstanding scenic and recreational values of the Missouri's free flowing waters. This will help ensure that tourists will continue to speak highly of the state's recreational amenities.

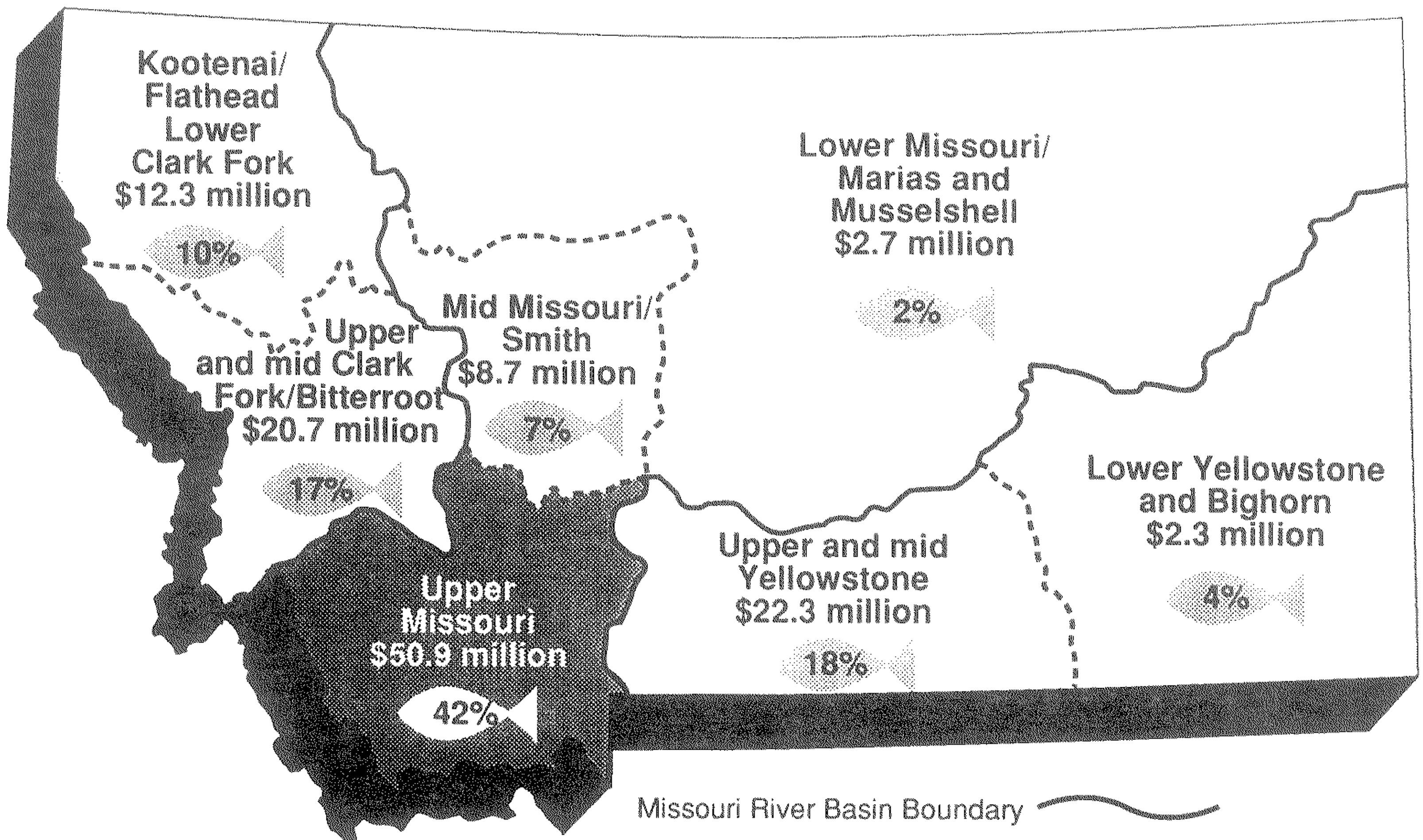
Since word of mouth is often the best advertisement for any commodity, satisfied tourists will in turn lead to continued growth for businesses supported by non-residents. Recent labor statistics for Montana revealed that growth in tourism-related, service-sector jobs is already significant. During the first half of the 1980s when the wood products, metal mining, energy development and agricultural industries were floundering, the service sector of Montana's economy steadily generated 18,000 new jobs (Powers 1987).

The recreational and aesthetic attributes of rivers and streams that attract tourists are also responsible for attracting new, economically-independent residents to Montana. As pollution, crowded conditions, crime rates and loss of natural areas continue to increase in major cities, an increasing number of retired people and/or persons endowed with sufficient interest, dividend or rent incomes, are choosing to move to areas with uncrowded, high-quality recreational opportunities and aesthetically-pleasing natural settings. Many of these people, especially those seeking unmatched fishing, floating and scenic values, are moving to the Missouri Basin in Montana. The contribution to Montana's economy made by these independent, "non-labor" income sources is already substantial; it presently accounts for over one-third of Montana's economic base. In recent years, non-labor income has added nearly 4 billion dollars per year to the state's economy, compared to Montana's total labor income of about 7 billion dollars per year (Op. Cit.).

Of the many recreational benefits provided by the rivers and streams of the Missouri Basin, fishing is unquestionably a highly-valued commodity. A recent economic study (Duffield et al. 1987) determined the total aggregate value of stream fishing in Montana to be $122,000,000 per year. Remarkably, $50,962,000 per year, 42% of the state-wide total, was attributable to streams and rivers in the basin above Canyon Ferry Reservoir (Figure 2). A breakdown of net recreational fishing values for streams in the upper Missouri Basin are presented in Table 4.

Figure 2. Net Recreational Fishing Values of Montana River Basins, 1985

Basin values were computed from information presented in Duffield et al. (1987). Numbers in fish outlines are percentages of state-wide stream fishing values found within the basins.



For the purpose of this map, the mid Missouri is the mainstem from Canyon Ferry Reservoir to the mouth of the Marias River.

TABLE 4

NET RECREATIONAL FISHING VALUES OF STREAMS
IN THE UPPER MISSOURI RIVER BASIN DURING 1985

Stream	Value Per Day	Annual Angler Days	Annual Site Value
Beaverhead River	$ 95.75	24,239	$ 2,321,000
Big Hole River	$108.55	47,910	$ 5,201,000
East Gallatin River	$142.80	6,191	$ 884,000
Gallatin River	$152.22	63,871	$ 9,722,000
Madison River	$161.06	108,712	$17,509,000
Jefferson River and Tributaries	$ 79.21	29,129	$ 2,307,000
Upper Missouri River and Tributaries above Canyon Ferry Dam	$ 87.72	25,419	$ 2,230,000
Madison River Tributaries	$254.04	11,224	$ 2,851,000
Gallatin and East River Gallatin Tributaries	$171.54	14,045	$ 2,409,000
Beaverhead Tributaries (Includes Ruby and Red Rock Rivers and Tributaries)	$139.47	25,878	$ 3,609,000
Big Hole River Tributaries	$103.07	18,621	$ 1,919,000
Total		375,239	$50,962,000

State Total $122,315,000

Percent of State Total 42%

Source: Duffield *et al*. 1987.

Of the 45 streams and/or stream reaches evaluated by Duffield et al., the upper Missouri Basin was found to contain three of the most highly valued rivers in the state. The Madison was the most valuable river in Montana ($17,509,000 per year). The Gallatin was the third most valuable stream in the state ($9,722,000 per year), while the Big Hole was fourth ($5,201,000 per year). Only the upper Yellowstone ($10,905,000 per year) was more highly valued than the Gallatin or Big Hole.

The net economic value of fishing in the Missouri River drainage between Canyon Ferry Reservoir and Fort Peck Dam was estimated to be $11,478,000 (Table 5). Approximately nine percent of the total fishing value of all streams in the state was derived from streams in the lower Missouri River Basin. Together, the streams in both the upper and lower Missouri River Basin accounted for about 51 percent of the statewide fishing-related values.

The site values listed in Tables 4 and 5 were computed by multiplying the value of a fishing day on a given stream times the fishing pressure (as determined by the 1985 DFWP angler use survey). A Travel Cost Model was used to calculate the value per day for each stream. See Duffield et al. (1987) for a detailed discussion of this model.

Duffield et al. caution that their study did not quantify the total economic value of streams in Montana. Rather, it only addressed the economic benefits derived by present angler use.

TABLE 5

NET RECREATIONAL FISHING VALUES OF STREAMS IN THE LOWER MISSOURI RIVER BASIN DURING 1985

Stream	Value Per Day	Annual Angler Days	Annual Site Value
Missouri River (between Marias River and Fort Peck Dam)	$ 77.84	22,340	$ 1,739,000
Missouri River (Canyon Ferry to Marias River excluding Holter to Cascade)	$ 61.36	67,557	$ 4,145,000
Missouri River (Holter to Cascade)	$ 50.33	72,788	$ 3,663,000
Marias River	$ 58.77	5,925	$ 348,000
Musselshell River	$ 55.96	11,218	$ 628,000
Smith River	$ 70.96	11,824	$ 839,000
Smith River Tributaries	$ 16.29	7,143	$ 116,000
Total		198,795	$11,478,000
State Total $122,315,000			
Percent of State Total 9.4%			

Source: Duffield et al. 1987.

These researchers further state that, based on the study's reported costs, the net present value (market value) of just fishing-related recreation for Montana streams is roughly 3.1 billion dollars.

In addition to fishing, streams provide many other recreational benefits. Floating, camping, picnicking, swimming, bird-watching, sight-seeing and hunting are also popular recreational activities conducted along the Missouri River and its tributaries. However, there is very little data available that allows for economic analysis of the values of stream recreation other than fishing. The economic value of the Missouri and other streams in Montana would, therefore, would be significantly higher than $122,000,000 per year if all river-based recreational activities were evaluated.

2. Economic Benefits to Other Uses or Parties

a. Municipalities

Municipalities will benefit from the DFWP reservation because of increased assurances about the future availability of drinking water. Maintenance of instream flow levels will, in turn, sustain water levels at city intake structures and infiltration galleries. If incremental stream flow depletions were to continue as they have occurred in the past, relocation of these supply structures and/or development of alternative water supplies could be necessary. Either of these alternatives would be costly for municipalities.

The effects of the DFWP reservation upon the availability of surface drinking water supplies are important considerations to be weighed during water reservation deliberations. However, the economic benefits of the reservation to stream-side communities also extend beyond the issue of municipal water supply sources. The recreational values of the free-flowing Missouri River system provide the basis for many thriving businesses in Ennis, West Yellowstone, Bozeman, Great Falls, Helena, Fort Benton, Three Forks and many other smaller river-side towns. The economic growth and stability of these communities, particularly the smaller ones, is highly dependent upon businesses supported by fishing, floating and other forms of river-based recreation.

Outfitting businesses, of course, most clearly benefit from the maintenance of adequate instream flows. The percentage of state-wide fishing-outfitting businesses that are located in the Upper Missouri Basin closely approximates the angler-use data displayed earlier in Figure 1. About 31% (83 out of 270) of the licensed fishing outfitters and guides who requested to be listed in the Department of Commerce's 1988 Montana Travel Planner were headquartered in cities and towns of the Upper Missouri Basin.

In 1986, a total of 205 registered Montana fishing outfitters provided 10,213 clients with 20,128 fishing days (Montana Department of Fish, Wildlife and Parks 1987). In that year, 187 outfitters also listed the major rivers that they worked. A total of 104 outfitters (56%) listed rivers and streams in the Missouri Basin.

Along with outfitting, municipalities in the Missouri Basin also depend upon the economic success of many other service sector businesses, ranging from motels, campgrounds and restaurants, to sporting goods stores, automobile service stations and gift shops. These businesses are highly dependent upon a steady supply of non-resident vistors. The DFWP reservation will help maintain the high quality recreational and scenic opportunities sought by tourists, thereby securing this aspect of economic prosperity for the Missouri Basin.

The DFWP reservation will unquestionably protect opportunities for the perpetuation and enhancement of recreational and service sector businesses; but, the amenities it helps maintain will also help attract new kinds of businesses offering employment opportunities beyond the scope traditionally credited to recreation. Specialty food and mail order companies, computer and data processing businesses, and consulting firms are examples of "distance-independent businesses," since they typically do not consider distance from markets a liability and, therefore, are often successful in "remote" areas like Montana.

In his keynote address to the Governor's "Montana - An Economy in Transition" conference in May 1986, Dr. David Birch, a nationally-renowned small business researcher, suggested as two of three major recommendations for improving Montana's economy that: (1) better recognition be given to attracting these kinds of businesses; and (2) that the state do a better job of promoting tourism (Birch 1986). Calling Montana "one of the most spectacularly beautiful places in the world," he concluded that the state should invest more effort towards promoting its natural attributes. This added promotion would not only enhance Montana's tourism businesses, the major source of economic growth in the state since 1980, but it would also most certainly help attract more distance-independent companies to Montana.

Areas of the state that are blessed with an abundance of spectacular trout rivers like the Upper Missouri River Basin, have the highest potential for attracting both tourists and distance-independent companies. In fact, significant new growth in the latter is already evident in the upper basin. During the past three years, several small to mid-sized companies have moved to Bozeman. Much of the credit for attracting these businesses can be given to the Gallatin Development Corporation (GDC), a local business advocacy group that has definitely followed the advice of Dr. Birch about promoting an area's natural beauty. According to the executive director of the GDC, recreational opportunities and local trout streams are major selling points for attracting new businesses to the Bozeman area. The GDC promotional video "Pioneering for the Future," mentions fly fishing several times. As well, <u>all</u> of the newly-arrived distance-independent companies have at some time commented on the recreational opportunities available in the area (Smith, 1988). Some examples of these new businesses include:

Gibson Guitar Company, which moved part of its Nashville, Tennessee operations to Bozeman during the summer of 1988, and expects to employ 60 people by late 1989.

CCG Inc., a specialized consulting firm helping market research ideas and concepts that are developed at Montana State University.

Life-Link, a sporting goods manufacturer that had expected to hire about 35 people during its first year in Bozeman, but greatly exceeded these expectations. The company started operations in March, 1988. By February, 1989, Life-Link had employed 75 full-time and 12 part-time employees. All but eight were from the Bozeman area. The company predicts that its annual sales this year will be near $9,000,000 and that it will employ 150 people within the next two years (Bozeman Chronicle 1989).

Patagonia, a world-famous outdoor clothing manufacturer, recently moved the mail order portion of its company to the Gallatin Valley. Initially employing about 30 people, this figure is expected to increase to 100 during the next five years. A spokeswoman for Patagonia stated that Bozeman was chosen by the company "primarily because of the recreational opportunities not available in Ventura" (the former California site of the mail order business). She continues, "Ventura is a great town, but there is not a lot of great rivers. You can't fly fish here either. Bozeman has all those things and you can get to [them] relatively easily." (Bozeman Chronicle, 1987)

The DFWP flow reservation will help protect the aesthetic qualities and recreational opportunities that will continue to attract the above economic benefits to municipalities. These benefits, along with the amenities provided by rivers and streams to residents of stream-side cities and towns, are important to the quality of life and the economic future of municipalities in the Missouri Basin.

b. Industry

Hydropower is a major beneficiary of the DFWP reservation. Nine hydroelectric facilities in the Montana portion of the Missouri Basin, including four near Great Falls, along with Holter, Hauser, Ennis, Canyon Ferry and Fort Peck dams, annually produce about 3.7 million megawatt hours of electricity (DNRC 1986). Nearly half of this electrical energy is produced at the two latter facilities.

Maintaining instream flows through a water reservation would provide monetary benefits through electrical generation at existing, publically-owned facilities. Water that is available in the Missouri River system not only passes through the Bureau of Reclamation's Canyon Ferry Dam and the Corps of Engineers' dam at Fort Peck, it also powers five other major hydropower generating facilities owned by the federal government in North Dakota and South Dakota. Table 6 presents the average generating capacity of each facility and the cumulative electrical generation per acre-foot of water as it passes from one facility to the next.

TABLE 6

KILOWATT HOUR (KWH) GENERATION PER ACRE-FOOT (AF) OF WATER (Median Water or Most Probable Runoff)

Power Plant	Average Generation (KWH/AF)	Cumulative (KWH/AF)
Gavins Point	35	777
Fort Randall	95	742
Big Bend	56	647
Oahe	154	591
Garrison	148	437
Fort Peck	164	289
Canyon Ferry	125	125

Source: Western Area Power Administration, January 20, 1984.

There are varying concepts of how water in streams and reservoirs are most appropriately valued. Both the Western Area Power Administration (WAPA) and the U. S. Army Corps of Engineers (Corps) have provided estimates of the value of an acre-foot of water in the Missouri River Basin for hydropower. The value of an acre-foot of water passing through the seven hydropower facilities would depend on the sale price of electricity. According to WAPA, the price of electricity ranges from 7.5 mils per kilowatt hour (KWH) for "firm" power to 14 mils per KWH for "surplus" power (Schirk 1987). Based on the cumulative generation of electricity through the Missouri River mainstem dams (Table 6), the value of an acre-foot of water would range from $5.83 to $10.88.

The indirect economic benefit of the DFWP reservation to the nine hydroelectric facilities in the Montana portion of the basin is also very significant. When the price of electricity, as quoted by the WAPA (OP.Cit.), is applied to the electrical production rates at these Montana facilities, the value of wholesale power produced ranges from $27,800,000 to $51,800,000 per year (i.e., 3.7 million megawatts per year x 7.5 to 14 mils per kilowatt hour). These estimated values are conservative. Roughly one half of the hydroelectric power production in the Missouri Basin in Montana is from private facilities, which typically receive a much higher sale price for their electricity (Dodds 1989).

Velehradsky (1987) provided a slightly lower estimate for the value of electrical production at the Corps of Engineers'

Missouri River facilities ($4.90/acre-foot). However, he also stated that the perceived benefits of hydropower are much greater than any current production estimates. If new power sources must be brought on line, the cost could be 60 mils per KWH or higher, or equivalent to about $41.00 per acre-foot.

The instream flows requested in this application and those required for existing hydropower facilities are mutually supportive, as long as water release schedules from these dams are closely tied to the needs of fish and water-based recreation. The reservation would help maintain the electrical generating capacity of the hydropower plants on the Missouri River, which currently provide some of the most economical electrical power in the western states.

The DFWP reservation will also help stabilize industrial waste treatment costs. Maintaining instream flows in the Missouri River Basin would help provide sufficient water volumes to dilute and assimilate wastewater discharges from existing facilities. The Montana Department of Health and Environmental Sciences (DHES) only issues discharge permits to waste treatment facilities where there are sufficient streamflows to dilute the wastes. Each discharge permit has criteria attached specifying that receiving waters would be protected as long as streamflow does not fall below the 7-day, 10-year low flow limit for a given stream. (The 7-day, 10-year low flow is the lowest flow that would occur at a probability of once every 10 years for a 7-day consecutive period.) If the flow of receiving water falls below the 7-day, 10-year limit, waste discharges would not necessarily be curtailed, but the biological integrity of the streams would no longer be protected (Bahls 1989).

Instream flow reservations would help prevent streams receiving wastewater discharges from dropping below the 7-day, 10-year low flow limit established to prevent water quality degradation and damage to aquatic ecosystems. If flows should be depleted below minimum levels to provide adequate dilution and assimilation of wastewater discharges, prevention of damage to aquatic ecosystems would only be avoided by suspending the discharge of wastewater to streams. Preventing permitted facilities from discharging during these periods could pose serious operational and economic consequences. Either treatment facilities would need to be upgraded to reduce the quantity of various chemical compounds and organic materials in wastewater, or effluents would have to be disposed of on land or through some other means. Such measures would be extremely expensive. Preventing damage to aquatic ecosystems through maintenance of instream flows would be more cost effective than upgrading waste treatment facilities or land disposal of wastewater.

Municipalities are also recipients of the above indirect economic benefit of the reservation, since there are nearly as many permitted municipal sewage treatment plant dischargers in the Missouri Basin (43) as there are industrial dischargers (46). All Montana Pollution Discharge Elimination System (MPDES) - permitted facilities in the Missouri Basin that receive benefits associated with stabilized instream flows/waste treatment costs are listed in Table 7.

TABLE 7

MONTANA PERMIT DISCHARGE ELIMINATION SYSTEMS - MUNICIPAL, INDUSTRIAL, AND PLACER MINE PERMITS

Permittee	County	Receiving Water	Permit Expiration Date
A. MUNICIPAL PERMITS			
Dillon	Beaverhead	Beaverhead River	01-31-89
Townsend	Broadwater	Missouri River	05-31-93
Belt	Cascade	Belt Creek	01-31-89
Great Falls WTP	Cascade	Missouri River	05-31-92
Great Falls	Cascade	Missouri River	09-30-92
Village Water & Sewer	Cascade	Sun River	03-31-93
Vaughn	Cascade	Sun River	12-31-89
Big Sandy	Chouteau	Big Sandy Creek	10-31-88
Geraldine	Chouteau	Flathead Creek	05-31-93
Chouteau/Highwood	Chouteau	Highwood Creek	01-31-89
Fort Benton WTP	Chouteau	Missouri River	05-31-89
Fort Benton WTP	Chouteau	Missouri River	08-31-91
Denton	Fergus	Wolf Creek	01-31-89
Lewistown	Fergus	Big Spring Creek	01-31-89
Willow Creek Sewer	Gallatin	Unnamed Drain Ditch	07-31-90
Bozeman	Gallatin	East Gallatin River	05-31-93
Three Forks	Gallatin	Madison River	10-31-89
Manhattan	Gallatin	Gallatin River	09-30-92
Cut Bank	Glacier	Cut Bank Creek	05-31-93
Browning	Glacier	Depot Creek/Willow Creek	05-31-86
Whitehall	Jefferson	Jefferson River	12-31-89
Hillbrook Nursing Home	Jefferson	Prickly Pear Creek	03-31-89
Boulder	Jefferson	Boulder River	03-31-89
Hobson	Judith Basin	Unnamed Drainage	09-30-88
Stanford	Judith Basin	Skull Creek	05-31-91
Helena	Lewis & Clark	Prickly Pear Creek	05-31-91
US BOR Canyon Ferry	Lewis & Clark	Missouri River	08-31-89
US BOR CF Govt Camp	Lewis & Clark	Missouri River	08-31-89
Helena WTP	Lewis & Clark	Prickly Pear Creek	09-30-91
East Helena	Lewis & Clark	Prickly Pear Creek	05-31-91
Sheridan	Madison	Mill Creek	03-31-89
Ennis	Madison	Madison River	09-30-88
White Sulphur Springs	Meagher	Lone Willow Creek	05-31-93
Valier	Pondera	Unnamed Dry Creek Bed	11-30-89
Conrad	Pondera	Marias River	07-31-89
Brady Water Users	Pondera	South Pondera Coulee	05-31-93

Table 7 (continued)

Permittee	County	Receiving Water	Permit Expiration Date
MUNICIPAL PERMITS (continued)			
Choteau	Teton	Teton River	01-31-89
Fairfield	Teton	Freezeout Lake	05-31-93
Dutton	Teton	Hunt Coulee	05-31-93
Toole/Sweetgrass	Toole	Unnamed Dry l. Bed	05-31-93
Sunburst	Toole	Unnamed Dry l. Bed	01-31-90
Shelby	Toole	Marias River	05-31-93
Fort Peck	Valley	Missouri River	05-31-93
B. INDUSTRIAL PERMITS			
Anaconda Minerals	Cascade	Missouri River	02-28-89
Janetski, Lee B.	Cascade	Missouri River	06-30-90
Antonioli, Mrs. P.	Cascade	Squaw Creek	12-31-89
MPC-Rainbow	Cascade	Missouri River	06-30-89
MPC-Black Eagle	Cascade	Missouri River	06-30-89
MT Refining Co.	Cascade	Missouri River	07-01-88
MPC-Ryan	Cascade	Missouri River	06-30-89
Genco Industries	Cascade	Belt Creek	07-31-92
Blue Range Mining	Fergus	Big Spring Creek	10-31-89
Blue Range Eng.	Fergus	East Fork Fords Creek	09-30-91
SourDough Cr. Prop.	Gallatin	Various	08-31-91
Ideal Basic Ind.	Gallatin	Missouri River	02-28-91
Beren Corp.	Glacier	Unnamed Slough	06-01-91
Flying J, Inc.	Glacier	Spring Coulee	05-31-93
Corbin Water Users	Jefferson	Corbin Creek	05-31-91
Boulder Hot Springs	Jefferson	Little Boulder River	05-31-92
MT Tunnels Mining	Jefferson	Trib. to Spring Creek	10-31-91
Pangea Mining	Jefferson	Basin Creek	05-31-93
Pangea Mining	Jefferson	Monitor Creek	05-31-93
Ash Grove Cement	Jefferson	Prickly Pear Creek	12-31-89
Gulf Titanium	Lewis & Clark	Jennies Fork	09-30-91
Black Hawk Mining	Lewis & Clark	Banner Creek	09-30-90
Clark, Dexter	Lewis & Clark	Spring Creek	12-31-92
MT Gold & Sapphire	Lewis & Clark	Missouri River	06-30-88
MPC-Holter	Lewis & Clark	Missouri River	06-30-89
MPC-Hauser	Lewis & Clark	Missouri River	06-30-89
Century Silver	Lewis & Clark	Ten Mile Creek	08-31-92
Liquid Air Corp.	Lewis & Clark	Prickly Pear Creek	12-31-89
Uncle Sam Mines	Madison	Middle Fork Mill Creek	04-30-92
U.S. Grant Gold	Madison	Alder Creek	01-31-92
Rocky Mtn. Minerals	Madison	Rochester Creek	05-31-89
Red Pine/Shermont	Madison	Indian Creek	02-28-90
MT Talc	Madison	Johnny Gulch Creek	09-30-92
Cyprus Ind. Min.	Madison	Middle Fork Stone Creek	07-31-89

Table 7 (continued)

Permittee	County	Receiving Water	Permit Expiration Date
INDUSTRIAL PERMITS (continued)			
MPC-Madison	Madison	Madison River	06-30-89
Denimil Resources	Madison	Pony Creek	12-31-89
Cyprus Ind. Min.	Madison	Sweetwater Creek	05-31-93
Zortman-Landusky	Phillips	King Creek	10-31-91
Zortman-Landusky	Phillips	Various	10-31-91
Malta Ready Mix	Phillips	Milk River-Dodson Canal	05-31-93
Western Reserves	Toole	Unnamed Closed Basin	07-31-89
Texaco, Inc.	Toole	Stockponds	10-31-88
Silver Fox Oil	Toole	Ephemeral Drainage	04-01-89
A & G Oil & Gas	Toole	Stockponds	04-30-88
East. Amer. Energy	Toole	Unnamed Coulee	12-31-87
Devon Water, Inc.	Toole	Tiber Reservoir	11-30-88
C. PLACER MINES & SUCTION DREDGES			
Golden Star	Beaverhead	Big Moosehorn Creek	09-90
Golden Star	Beaverhead	Ruby Creek	09-90
Golden Star	Beaverhead	Little Moosehorn Creek	09-90
Miragliotta, Vito	Beaverhead	Jeff Davis Creek	08-88
Searle Bros.	Beaverhead	Jeff Davis Creek	03-93
Towner, Bob	Beaverhead	Grasshopper Creek	07-89
Wright, Alan	Broadwater	Indian Creek	03-92
Klies, Forrest	Jefferson	Jack Creek	10-90
Klies, Forrest	Jefferson	Basin Creek	10-90
Jefferson Creek	Lewis & Clark	Jefferson Creek	06-86
Holzworth, Dick	Lewis & Clark	Skelly Creek	03-88
Modern Expl., etc.	Lewis & Clark	Prickly Pear Creek	12-92
Morris, Bud	Lewis & Clark	Hauser Lake	05-93
MT Gold & Sapphire	Lewis & Clark	Missouri River	06-88
Fredriksen, etc.	Lewis & Clark	Missouri River	12-92
Sypult, Cleatus	Lewis & Clark	Madison Gulch	10-90
Placer Recovery	Lewis & Clark	Jefferson Creek	02-93
Brown's Gulch	Madison	Brown's Gulch Creek	09-86
Parker, Rodney	Madison	Barton Gulch	06-90
Lince, Carol G.	Madison	California Creek	08-92

Source: Montana Department of Health and Environmental Sciences, Helena, Montana, 1988.

Lastly, and very importantly, the diversity and abundance of water-based recreational opportunities that are supported by the DFWP reservation provide the base for a highly diverse, environmentally-sensitive industry in the Missouri Basin. The amenities protected by the reservation support water-based recreational businesses and also attract tourists, "distance-independent" businesses and people with independent incomes. All of these businesses and income sources collectively comprise an amenity-based, growth-oriented industry that is essential to the continued growth and prosperity of the basin.

c. Agriculture

Existing agricultural water right holders will benefit from the DFWP reservation because of increased legal and physical assurances about future delivery and supply of water for their crops and livestock. Although the long-term stability that will be provided to these landowners has not been quantified economically, it is no doubt substantial as far as its influence on property values, crop production rates and reductions in potential legal costs arising from disputes between junior and senior water users. However, since no firm monetary data exist for these economic benefits, they have been incorporated into the discussion about non-economic benefits of the reservation (II.2.c).

B. Effects of the Reservation on the Environment, Public Health, Welfare and Safety

1. An Overview of Indirect, Non-Economic Benefits

The scenic and recreational values of rivers are largely a function of their water quantity (instream flows), water quality and riparian areas. As has been previously discussed, the DFWP reservation preserves these attributes, which are vital components of the Missouri Basin's **natural environment.** In fact, all direct benefits of the reservation are also indirect benefits to the environment, since the DFWP is a public agency charged with the protection and enhancement of other significant components of the natural environment, i.e Montana's fish, wildlife and parks.

However, protection of the natural environment through adequate instream flows does far more than just preserve hydrologic conditions and biological abundance. It also benefits the **human environment**, as well as the public's health, welfare and safety.

The combination of exercise and relaxation that is part of fishing, floating and other water-based recreation unquestionably benefits physical health, while providing welcome relief from the mental stresses of everyday life. These recreational activities also require varying degrees of skill, and so become avenues for gaining a sense of personal accomplishment. To improve these skills requires better understanding of the functions of river systems; this, in turn, increases individual consciousness and self-confidence.

The sociological benefits of river recreation are also important. River outings provide opportunities for families and friends to socialize or meet new people in a relaxed and aesthetically-pleasing setting. Sharing these pleasant experiences benefits and expands interpersonal relationships.

Many people float rivers only to fish, but others enjoy the cultural and historical aspects associated with free-flowing streams throughout the Missouri Basin. Retracing the journeys of early explorers like Lewis and Clark, Mullan, Colter, Bozeman and others, certainly requires adequate instream flows for present day river navigators. Yet, just as importantly, these streamflows also preserve the natural setting or viewing backdrop of river bottoms, which has other important cultural and historic implications.

For example, the scene at the Big Hole Battlefield National Monument would be greatly diminished without adequate instream flows--for it was within the lush riparian vegetation and braiding stream channels of Trail Creek that Chief Joseph and his band of Nez Perce confronted the U. S. Army. Further reductions in instream flows and/or riparian vegetation within the battlefield area would change the physical setting, and thus the historical and cultural experience of visitors. In a similar sense, it would be difficult to conjure up images of John Colter using the Gallatin River as a hiding place from fleet-footed warriors if the river near Headwaters State Park were to become further dewatered. And, the Missouri's Wild and Scenic stretch would not offer visitors the same historic feel if it no longer had streamflows similar to those that existed during the steamboat era.

In stories and songs--from Native American lore to the writings of today's authors and poets--rivers are never described merely as physical conduits where water runs downhill. Rather, it is the beauty or strength of rivers and/or the influence of rivers upon individuals or societies that resonates through human memory.

The rivers and streams of the Missouri Basin, therefore, not only provide ongoing recreational and health benefits, they are also vital and important linkages to our past. These free-flowing waters and the riparian vegetation that they nourish are as much a part of the historical, social and cultural environment of the basin as are any human-fabricated structures or devices. The DFWP instream flow reservation will, in essence, protect irreplaceable components of the Missouri Basin's human environment.

Adequate instream flows are also important to the safety of floaters. Hazards, such as large boulders, logs, gravel bars, rip rap, and diversion structures, can be avoided by floaters if stream flows are high enough to allow manuevering.

In the sections that follow, other indirect non-economic benefits of the reservation to other uses or parties will be described. It is important to note that **there are no indirect,** non-economic costs of the reservation to the environment, public health, welfare or safety.

2. Non-Economic Benefits to Other Users or Parties

a. Municipalities

The instream flows requested in the DFWP reservation will continue to enhance the human environment for municipal residents in the Missouri Basin. Adequate stream flows will help enhance the visual attributes of river bottom lands by keeping riparian plant communities healthy and viable and by providing habitat for wildlife and birds that residents enjoy observing. The attractiveness of a stream is also closely tied to its water level; discharge levels below those requested in this application would lead to increases in exposed (dewatered) channel reaches as well as decreases in total living space available for trout and other aquatic life. The reservation will help preserve both the volume and surface area of streams, thereby perpetuating sport fishing and, where presently conducted, river floating opportunities. These amenities are substantial and irreplaceable social, aesthetic and recreational benefits of the reservation for citizens of municipalities that border free-flowing streams. The opportunity to fish, float or swim in the streams, observe wildlife and birds, or to just enjoy the serenity of sparkling waters beneath the shade of cottonwoods in a city park, all contribute immeasurably to the quality of life in these communities.

A major public health benefit of the DFWP Reservation is its role in protecting municipal water supplies. Many municipalities in the Missouri Basin utilize surface water or shallow, stream-side aquifers as their drinking water sources. The reservation will help maintain stream discharge levels necessary to dilute the toxic effects of hazardous materials and microbial organisms that enter these streams. Some herbicides and pesticides that are used by farmers, ranchers, weed districts, and urban gardeners/lawn-growers are quite persistent (slow to decompose). Leaks, spills or improper application, storage and disposal of these chemicals result in contaminated surface and ground waters. Unless adequate dilution is available, concentrations of these substances in public water supplies can reach levels harmful to human health.

The benefit of maintaining adequate instream flows to dilute toxic substances is illustrated in the Missouri Basin by problems associated with the toxic element arsenic. High concentrations of this metal originate from geothermal sources in Yellowstone Park and enter the Missouri River drainage via the Madison River (U. S. Geological Survey 1987). Tributaries to the Madison dilute arsenic concentrations, lowering concentrations downstream. The Environmental Protection Agency (EPA) measured arsenic concentrations of 200 to 300 micrograms per liter (ug/l) in the upper Madison River and concentrations of 20 to 40 ug/l in the Missouri River upstream from Canyon Ferry Reservoir (at Toston). Human health concerns exist because the allowable limit for arsenic in drinking water is 50 ug/l (U. S. Environmental Protection Agency 1986).

Data collected by the U. S. Geological Survey (USGS) in 1985 (U. S. Geological Survey 1987), show that arsenic levels exceed drinking water standards in the Madison River below Hebgen Lake (i.e., 78 to 180 ug/l), below Ennis Lake (49 to 100 ug/l), and at Three Forks (45 to 87 ug/l). Arsenic levels in the Missouri River at Toston ranged from 22 to 40 ug/l and below Canyon Ferry Reservoir from 22 to 34 ug/l.

Between March, 1986, and September, 1988, 16 samples were collected by the USGS from the Madison River at the Yellowstone Park boundary near West Yellowstone. The mean concentration of arsenic was 252 ug/l (max. = 360; min. = 140) (Knapton 1989). The Jefferson and Gallatin rivers which do not have high arsenic concentrations are normally major diluters of the arsenic concentrations in the Madison River. A water sample collected by USGS on August 17, 1988 (a drought year) at Toston contained 100 ug/l dissolved arsenic (twice the EPA drinking water standard). The previous maximum concentration recorded from 58 samples collected at that site since 1972 was 52 ug/l. The mean concentration of all 58 samples was 24 ug/l (Op.Cit.).

Extremely low flows prevailed in the Jefferson and Gallatin rivers in 1988. On August 17, 1988, the flow in the Jefferson River was only 52 cubic feet per second (8 percent of the long-term daily mean flow) and the Gallatin River was at only 60 percent of its long-term mean daily flow (Op.Cit.). This lack of streamflow for dilution caused the increased concentration of arsenic at Toston on August 17, 1988, illustrating the importance of adequate instream flows to protect the quality of public water supplies.

b. Industry

The two largest hydroelectric facilities on the Missouri River in Montana, Canyon Ferry and Fort Peck, are operated by the federal government. Maintaining instream flows will benefit public welfare by assuring reliable water delivery for power generation at these federal facilities.

Many headwater trout streams in the Missouri Basin are presently impaired by discharges of acid and toxic metals from abandoned mining operations, i.e the upper Wise River, Boulder River, Prickly Pear Creek (near Helena), Belt Creek (near Great Falls), Grasshopper Creek (near Bannack), and others. Reduction in instream flows would, in turn, reduce the capacity of these streams to dilute the discharges, causing toxicity problems to spread farther downstream. This would result in degradation of more miles of viable trout streams.

c. Agriculture

Regardless of the amount of water apportioned for instream flow reservations, existing water rights in the basin will at all times be honored. In fact, if the DFWP's reservation is granted, existing water users will be provided with additional assurances of future surface and groundwater availability. Reserved instream flows will help maintain water levels at existing headgates and will provide a legal buffer to counter any future water development plans by new water users. During low flow years, maintenance of existing stream flows will also help ease conflicts between junior and senior water users in the basin.

Instream flows often recharge shallow, alluvial groundwater tables that adjoin rivers and streams. Maintenance of these vital groundwater systems provides additional benefits to agriculture:

The riparian vegetation that is supported by shallow groundwater, i.e. willows, cottonwood, birch and aspen, all have extensive root systems that stabilize stream banks and channels. The soil stability provided by healthy, well-managed riparian areas not only prevents erosion, but also reduces the potential for damage to crops and farm buildings caused by flooding.

In many valleys of the upper basin, moist meadows and other riparian-like areas are often used to grow alfalfa and hay crops, or as highly productive pasture lands. Many of these sites are "sub-irrigated" by shallow water tables that are recharged by surface water supplies. The DFWP reservations would help maintain these moist growing sites by protecting flows against new water uses. New diversions could reduce essential recharge which, in turn, could reduce the forage productivity of these existing agricultural lands. A reduction in recharge would most certainly occur if the new offstream use were to be located on benchlands not directly connected to shallow, stream-side aquifers.

Finally, stream-side aquifers are often utilized as domestic, livestock or irrigation water supplies. The reservation would help sustain existing water table levels, and thereby, the availability and/or quantity of these shallow groundwater supplies.

C. Economic Opportunity Costs of the Reservation

1. An Overview of Indirect Economic Costs

Agriculture is by far the largest offstream consumptive water user in Montana, accounting for approximately 97.6% (15.41 million acre-feet) of the water diverted. In the Missouri Basin in Montana, agriculture accounts for an even larger share of the water diverted by consumptive users, approximately 99% (7.99 million acre-feet). Of this diverted water, only about 22% (1.76 million acre-feet) is actually consumed (DNRC 1986). Loss of water to the atmosphere from reservoir surfaces likely results in a nearly equal amount of water consumption in the basin. Estimates for reservoir evaporation losses specific to the Missouri Basin were not presented in the 1986 DNRC report; however, during 1980 on a state-wide basis, evaporation from reservoirs was estimated to account for 53.8% of all water consumption in Montana, compared to 44.6% by agricultural users.

In the Missouri Basin in Montana, use of surface water by municipalities and industry is relatively minor, about 1% of total water consumption. During 1980, 0.071 million acre-feet of water was diverted for municipal use, but only 0.025 million acre-feet was consumed. Water withdrawals for industry-owned water supplies were even less, amounting to only 0.003 million acre-feet in 1980 (Op.Cit.). Even when the more highly populated and industrialized lower Missouri River states are included in these figures, non-agricultural uses are still relatively insignificant, amounting to less than 4% of the water consumed in the entire ten-state basin (O'Keefe, et al. 1986).

Agricultural uses of water are primarily for irrigation and to a lesser extent for stock watering. Industrial uses include mining (placer and ore processing), manufacturing (process and cooling water) and hydropower. Municipal use is primarily for public water supplies.

2. Economic Costs to Other Uses or Parties

a. Municipalities

Future water demands for municipalities are difficult to predict, not only because of problems associated with growth projections for cities and towns, but also because of uncertainties about the cost-effectiveness of surface water supplies in the future. Recent outbreaks of Giardiasis in Bozeman and other smaller communities in the Basin have prompted the need for additional treatment of surface drinking water supplies. Giardia cysts are not destroyed by conventional water treatment methods. Filters, which are large, costly and difficult to operate and maintain, are presently the most commonly-prescribed treatment for removing the minute cysts.

Giardiasis is spread by mammalian feces. During the past decade its incidence has increased dramatically in surface waters of the Northern Rockies. Because of the Giardiasis outbreak and other water quality considerations, the 1986 Amendments to the Federal Safe Drinking Water Act require that all surface drinking water supplies be subjected to additional filtration requirements by the early 1990s. Treatment costs for surface drinking water sources will, therefore, inevitably increase, which will decrease the economic attractiveness of these sources as future drinking water supplies.

Presently, five municipalities in the upper Missouri River basin are planning to need more water to supply commercial, residential, and industrial needs by the year 2025 (HKM Associates 1987). Three of the communities (Dillon, Three Forks, and Belgrade) plan to obtain the needed water from wells, whereas West Yellowstone and Bozeman will supplement their water supply from surface waters.

West Yellowstone plans to pump 2,550 acre-feet per year from Whiskey Springs at a rate of 1,582 gpm by the year 2025. Bozeman predicts that it will need an additional 4,030 acre-feet per year to supplement ground water sources and water available from Hyalite Reservoir. Bozeman plans to construct a dam on Bozeman Creek to provide the water required by the year 2025.

Granting of instream flow reservations would probably not conflict with the needs of Bozeman for additional water because the proposed dam on Bozeman Creek would probably fill during the high flow period in the spring when requested instream flows are normally exceeded. Instream flow reservations could affect West Yellowstone's proposed project because no water storage is anticipated. However, such an effect would depend on the priority date of the instream reservations. Instream reservations would not conflict with those communities obtaining additional water from wells.

b. Industry

Within the ten-state Missouri Basin, the largest industrial use of water is for thermoelectric power generation; in 1978, 0.443 million acre-feet of water was diverted for the cooling water needs of coal-fired plants (O'Keefe et al. 1986). However, there are no thermoelectric plants in the portion of the Missouri Basin covered by this reservation request. Even if there were, the water needs for this industry would be relatively minor. For example, water withdrawals for the seven coal-fired electric plants in the Yellowstone Basin amounted to 0.094 million acre-feet in 1980, but only about 10% of this water was actually consumed (DNRC 1986). As well, if any coal-fired plants were to be built near Fort Peck Reservoir, water would be available for lease pursuant to authority granted by the 1987 Legislature (HB 608).

Mining and processing of mined products is an important industry in the Missouri River Basin in Montana. Currently, there are approximately 36 active mining operations in the basin that have been issued permits by the Montana Department of State Lands (DSL) for the mining of talc (5 permits), gold (16 permits), limestone (5 permits), gypsum (2 permits), silica/quartz (6 permits), iron (1 permit), and chlorite (1 permit) (Table 8).

TABLE 8

OPERATING MINES PERMITTED BY THE DEPARTMENT OF STATE LANDS IN THE MISSOURI RIVER BASIN

Company	County	Stream Drainage	Product	Process
Mt. Heagan Development Inc.	Jefferson	Boulder River	Gold	Cyanide Heap Leach
Searle Bros. Construction, Inc.	Beaverhead	Horse Prairie Cr	Gold	Placer
S and G Mining	Jefferson	Boulder River	Gold	Placer
Browns Gulch Mining	Madison	Alder Gulch	Gold	Placer
RLTCO	Beaverhead	Grasshopper Creek	Gold	Placer
Golden Sunlight Mine	Jefferson	Jefferson River	Gold	Cyanide Vat Leaching
Golden Star Mine	Beaverhead	Big Hole River	Gold	Placer
Continental Lime Inc.	Jefferson	Indian Creek	Limestone	Quarry
Hemphill Bros. Inc.	Jefferson	Boulder River	Quartz	Quarry
Stauffer Chemical Co.	Beaverhead	Big Hole River	Quartz	Quarry
Ideal Basic Industries	Gallatin	Missouri River	Limestone	Quarry
Cyprus Industrial	Madison	Madison River	Talc	Mine
Cyprus Industrial	Madison	Madison River	Talc	Mine
Cyprus Industrial	Beaverhead	Beaverhead River	Talc	Mine
Pfizer Inc.	Beaverhead	Beaverhead River	Talc	Mine
Willow Creek Talc	Madison	Ruby River	Talc	Mine
Cyprus Industrial	Jefferson	Jefferson River	Chlorite	Mine
Spotted Horse	Fergus	Spotted Horse Gulch	Gold	Cyanide Leach
Pauper's Dream	Lewis & Clark	Ten Mile Creek	Gold	Cyanide Leach

Table 8 (continued)

Company	County	Stream Drainage	Product	Process
Pegasus	Phillips	Ephemeral Drainage	Gold	Cyanide Leach
Montana Tunnels	Jefferson	Spring Creek	Gold	Cyanide Leach
Mortenson Const.	Cascade	Missouri River	Gravel	Quarry
Intergem	Meagher	Missouri River	Iron	Open Pit
Walter Savoy	Cascade	Sun River	Rip-rap	Quarry
Chouteau County	Chouteau	Teton River	Rock rip-rap	Quarry
Ash Grove Cement	Jefferson	Prickly Pear Creek	Limestone	Quarry
U.S. Gypsum	Jefferson	Prickly Pear Creek	Gypsum	Quarry
Maronick Const.	Judith Basin	Judith River	Gypsum	Quarry
Maronick Const.	Jefferson	Prickly Pear Creek	Limestone	Quarry
Special Lady	Lewis & Clark	Ten Mile Creek	Gold	Placer
St. Joseph	Lewis & Clark	Ten Mile Creek	Gold	Placer
Gulf-Titanium	Lewis & Clark	Little Prickly Pear Creek	Gold	Cyanide Leach
AMAX	Judith Basin	Judith River	Gold/ Silver	Cyanide Leach
Kendall Venture	Fergus	Judith River	Gold	Cyanide Leach
Pacific Silica	Jefferson	Prickly Pear Creek	Silica	Quarry
Indian Creek	Jefferson	Indian Creek	Limestone	Quarry

Source: Montana Department of State Lands, Helena, Montana. Permit Application Files (November, 1988).

The existing gold mines are primarily placer mines which are non-consumptive water users, and mines which extract gold through cyanide leaching of ore. Quartz and limestone are quarried for the production of cement, the processing of which consumes no water except for domestic purposes (i.e., drinking water and wastewater treatment). Talc and gypsum chlorite mines consume little or no water in mining and processing.

Additional gold mines have permits pending in the Upper Missouri River Basin. The AGAU/Montoro Joint Venture in the Rattlesnake Creek drainage near Argenta proposes to process ore through cyanide heap leaching. The Yellowband Mine, also near Argenta, would process gold and silver ore through a flotation mill.

New gold and silver mines probably would be the largest future industrial consumers of water in the Missouri River Basin in Montana. To estimate the amount of water that might be needed by future mines, water use by existing mines in Montana has been determined (Table 9). Water use for 13 mines obtaining water from both surface and ground water sources was 6,882.6 gallons per minute (gpm) for processing 208,400 tons of ore. Average water use was 529.4 gpm and average ore production was 16,031 tons per day (an average of 1 gpm is required to process 30 tons per day of ore).

Water use and production for mines obtaining water from surface sources (Table 10) was compared with water use and ore production for mines obtaining water from ground water sources

TABLE 9

WATER REQUIREMENTS, WATER SOURCES, AND PRODUCTION OF PERMITTED PRECIOUS METAL MINES IN MONTANA

Mine	County	Production (tons/day)	Water Consumption (gpm)	Water Source
Spotted Horse	Fergus	50	1.6	Discharge from existing adit
Pauper's Dream	Lewis & Clark	1,500	28	Wells
ASARCO-Troy	Lincoln	60,000	1,700	Wells
Pegasus	Phillips	80,000	1,700	Wells
Jardine	Park	1,050	300	Bear Creek and Pine Creek
Beal Mountain	Silver Bow	5,500	200	Beef-straight Creek
Chartam	Broadwater	3,000	300	Wells
CoCa	Flathead	5,000	660	Wells
Black Pine	Granite	1,000	5	South Fork Lower Willow Creek
Montana Tunnels	Jefferson	15,000	918	600 to 900 gpm from Spring Creek, Prickley Pear Creek, and Clancy Creek, 90 gpm from adits
Golden Sunlight	Jefferson	35,000	700	Jefferson Slough
Mt. Heagan	Jefferson	300	20	Slaughterhouse Gulch Creek
Stillwater	Stillwater	1,000	350	Mine workings & wells
Total		208,400	6,882.6	
Average		16,031	529.4	

1 gpm to process 30.3 tons/day

Source: Montana Department of State Lands, Helena, Montana. Permit Application Files (November, 1988).

Note: All of these mines are not in the Missouri River Basin.

TABLE 10

WATER REQUIREMENTS AND PRODUCTION FOR PERMITTED PRECIOUS METAL MINES OBTAINING WATER FROM SURFACE SOURCES IN MONTANA

Mine	County	Water Production (tons/day)	Water Consumption (gpm)	Water Source
Jardine	Park	1,050	300	Bear Creek and Pine Creek
Beal Mountain	Silver Bow	5,500	200	Beefstraight Creek
Black Pine Willow	Granite	1,000	5	South Fork Lower Creek
Golden Sunlight	Jefferson	35,000	700	Jefferson Slough
Mt. Heagan	Jefferson	300	20	Slaughterhouse Gulch Creek
Montana Tunnels	Jefferson	15,000	300	Spring Creek
Total		57,850	1,525	
Average		9,642	254	
1 gpm to process 38 tons/day				

Source: Montana Department of State Lands, Helena, Montana, Permit Application File (November, 1988)

(Table 11). Mines obtaining water from surface sources processed a total of 57,850 tons of ore per day and used 2,197,440 gallons of water per day (1 gpm to process 38 tons/day). Mines obtaining water from ground water sources processed 150,550 tons of ore per day and used 6,825,600 gallons of water per day (1 gpm to process 31.8 tons/day). Approximately 72 percent of the ore mined was processed utilizing ground water.

The impact that water reservations would have on future mining development in the Missouri River Basin would be related to the number of new mines opened and the water sources used to process ore. Estimating the numbers of mines that would open is speculative given the volatile nature of precious metals prices. Typically, gold and silver mining follow "boom and bust" cycles. Although mining in Montana may currently be expanding, it is not possible to predict whether this trend will continue.

According to McCulloch et al. (1988), gross production in 1988 from metal mines in Montana was up 45 percent from the previous year. The number of new or renewal exploration permits issued by the Montana Department of State Lands also has increased from 56 in 1982 to 111 in 1987 and 192 in 1988 (McCulloch et al. 1988). Although it is speculative to predict future precious metal mining activities in the Missouri River Basin, a 7-year trend of wages and salaries paid to miners in the Missouri River Basin was tabulated for 1981-87 (Table 12). As shown in Table 12, mining in the Missouri River Basin provided 41.2 percent of salaries and wages paid throughout the state for

TABLE 11

WATER REQUIREMENTS AND PRODUCTION FOR PERMITTED PRECIOUS METAL MINES OBTAINING WATER FROM GROUND WATER SOURCES IN MONTANA

Mine	County	Production (tons/day)	Water Consumption (gpm)	Water Source
Pauper's Dream	Lewis & Clark	1,500	28	Wells
Spotted Horse	Fergus	50	1.6	Discharge from existing adit
ASARCO-Troy	Lincoln	60,000	1,700	Wells
Pegasus	Phillips	80,000	1,700	Wells
Chartam	Broadwater	3,000	300	Wells
CoCa	Flathead	5,000	660	Wells
Stillwater	Stillwater	1,000	350	Mine workings & wells
Total		150,550	4,739.6	
Average		21,507	677	
	1 gpm to process 31.8 tons/day			

Source: Montana Department of State Lands, Helena, Montana. Permit Application Files (November, 1988).

TABLE 12

WAGES AND SALARIES FROM METAL MINING IN THE
UPPER AND LOWER MISSOURI RIVER BASIN
(Thousands of Dollars)

		Lower Missouri River Basin		Upper Missouri River Basin	
Year	State Total	Wages/Salaries	Percent of State Total	Wages/Salaries	Percent of State Total
1987	$48,078	$7,876	16.4%	$11,937[1]	24.8%
1986	$33,944	$4,928	14.5%	$ 5,760	17.0%
1985	$26,812	$3,392	12.6%	$ 5,091[2]	19.0%
1984	$32,988	$6,737	20.4%	$ 4,864[3]	14.7%
1983	$44,683	$4,311	9.6%	$ 6,044	13.5%
1982	$52,448	$3,406[4]	6.5%	$ 2,307	4.4%
1981	$57,756	$4,359[5]	7.5%	$ 2,392	4.1%
Average	$42,387	$5,001	11.8%	$ 5,485	12.9%

Source: Montana Department of Labor and Industry, Montana Employment, Wages, and Contributions, Annual Average 1981-1987.

[1]Excludes Broadwater County for purposes of confidentiality.

[2]Excludes Beaverhead County for purposes of confidentiality.

[3]Excludes Gallatin County for purposes of confidentiality.

[4]Excludes Meagher County for purposes of confidentiality.

[5]Excludes Cascade County for purposes of confidentiality.

metal mining in 1987. Wages and salaries increased in the upper Missouri River Basin from $2,392,000 in 1981 to $11,937,000 in 1987. In the lower Missouri River Basin, wages and salaries increased from $4,359,000 in 1981 to $7,876,000 in 1987.

Fairly reliable estimates of the remaining precious metals resources in the Missouri River Basin can be derived by examining past mining activities in the basin because future mining is predicted to occur where mining has historically taken place (Webster and Hahn 1988). New mining and ore processing technologies have made it economically feasible to extract metals from ore bodies that were previously not mined. According to Hahn (1988), minimum reserves of gold and silver in Montana are 8,012,000 and 617,165,000 ounces, respectively. Historic production of gold and silver in Montana was 20,396,000 and 950,253,000 ounces, respectively. The ratio of present estimated metal reserves to past production is 1:2.5 for gold and 1:1.5 for silver. If the estimated reserves of gold were correct, there are approximately .40 ounces of gold reserves for every ounce that already has been mined. Similarly, there are approximately .67 ounces of silver reserves for each ounce that has been mined.

To obtain an estimate of gold and silver reserves in the Missouri River Basin, historic gold and silver production was tabulated for mining districts in the basin (Table 13). Approximately 57 percent of all gold and 16 percent of all silver mined in the state came from mining districts in the Missouri River Basin. Assuming that the ratio of reserves to mined

TABLE 13

HISTORIC EXTRACTION OF GOLD AND SILVER IN THE MISSOURI RIVER BASIN[1]

Mining District	County	Production (ounces) Gold	Silver
Argenta	Beaverhead	64,400	562,000
Bannack	Beaverhead	387,000	141,000
Bluewing	Beaverhead	500	470,000
Bryant	Beaverhead	17,400	13,924,000
Elkhorn	Beaverhead	2,000	387,000
Polaris	Beaverhead	300	120,000
Vipond	Beaverhead	1,100	1,025,000
Confederate Gulch	Broadwater	650,000	7,570
Park	Broadwater	120,000	394,000
Radersburg	Broadwater	325,000	311,000
Winston	Broadwater	118,000	2,058,000
Neihart	Cascade	67,000	29,070,000
North Moccasin	Fergus	450,000	50,000
Warm Springs	Fergus	335,00	317,000
Alhambra/Basin	Jefferson	15,400	118,000
Boulder	Jefferson	480,000	14,770,000
Clancy	Jefferson	140,000	2,500,000
Elkhorn	Jefferson	100,000	12,600,000
Whitehall	Jefferson	563,000	277,000
Wickes	Jefferson	372,000	47,700,000
Barker	Judith Basin	3,500	2,738,000
Gould/Stemple	Lewis & Clark	345,000	500,000
Heddleston	Lewis & Clark	—	1,409,000
Lincoln	Lewis & Clark	682,000	120,000
Marysville	Lewis & Clark	1,390,000	8,880,000
York	Lewis & Clark	335,000	—
Rimini/Scratchgravel	Lewis & Clark	100,000	100,000
Norris	Madison	265,000	102,000
Pony	Madison	346,000	227,000
Renova	Madison	162,000	113,000
Sheridan	Madison	40,000	105,000
Silver Star	Madison	225,000	152,000
Tidal Wave	Madison	33,400	133,000
Virginia City	Madison	2,617,000	1,456,000

Table 13 (continued)

Mining District	County	Production (ounces) Gold	Silver
Washington	Madison	16,600	42,000
Castle Mountain	Meagher	—	4,270,000
Little Rockies	Phillips	960,000	2,440,000
Total		11,728,600	149,688,570
State Total		20,396,000	950,253,000
Percent of State Total		57.5%	15.7%

Source: Hahn, 1988. Gold and Silver Districts in Montana.

Note: Only mines which have produced more than 10,000 ounces of gold or more than 100,000 ounces of silver are listed.

production were 1:2.5 for gold and 1:1.5 for silver, there would be approximately 4,691,440 ounces of gold reserves and 100,224,342 ounces of silver reserves remaining in historic mining districts in the Missouri River Basin. Approximately 28 percent of the original reserves of gold and 40 percent of the original reserves of silver remain to be mined in the Missouri River Basin, provided new technologies allow for cost-effective extraction of these metals.

Basing future metals production in the Missouri River Basin on past statewide production (as just discussed) may underestimate the future metals reserves in the basin. Data for "proven" gold and silver reserves in the Missouri River Basin as of January 1989 (Hahn 1989) are shown in Table 14. (Proven reserves are silver and gold deposits that have been measured by actual exploration methods; it is assumed that metals from these ore bodies could be economically extracted at 1988 metals prices.) Assuming that both the statewide metals reserves and the Missouri River Basin proven reserves are correct, proven gold reserves in the basin would be 91 percent of the total state reserves. Similarly, the proven silver reserves in the basin would be 34 percent of the total state reserves.

Reservations of instream flows in the Missouri River drainage would have no impact on existing mining or new mines utilizing ground water, but they could affect future mining and ore processing if the new mines would rely entirely upon surface water for consumptive purposes. Development of new mines

TABLE 14

PROVEN GOLD AND SILVER RESERVES
IN THE MISSOURI RIVER BASIN

District	Gold Reserve	Silver Reserve
Winston	360,000	--
North Moccasin	60,000	--
Warm Springs	24,000	175,000
Elkhorn	500,000	--
Whitehall	2,500,000	2,500,000
Wickes	2,520,000	23,660,000
Lincoln	103,000	120,000
Marysville	50,000	--
Rimini	270,000	--
Jardine	330,000	--
New World	100,000	--
Little Rockies	500,000	7,750,000
Total	7,317,000	34,205,000

Source: Montana Department of State Lands, Helena, Montana, 1989.

requiring surface water could be adversely affected, particularly during periods of low stream flow, unless water storage facilities were utilized or alternative groundwater supplies were available. At the same time, the water quantities needed are small, based on traditional water use.

c. Agriculture

Revenues from agriculture in the Missouri River Basin are nearly equally provided by livestock and crop production. Average cash receipts from crops for the 7-year period (1980-86) contributed approximately 43 percent of the total state crop revenues (see average values in Tables 15 and 16). Similarly, livestock production in the Missouri River Basin provided about 43 percent of total state livestock revenues (see average values in Tables 15 and 16).

Irrigated land in the Missouri River Basin comprises about 50 percent of all irrigated land in the state (Tables 17 and 18). Non-irrigated land in the basin makes up about 43 percent of all dryland agriculture on a statewide basis (Tables 17 and 18). The upper Missouri River Basin has about 24 percent of the irrigated land in the state (Table 17), whereas the lower basin has approximately 25 percent of the State's irrigated land. The lower basin differs from the upper basin primarily in the amount of dryland farming. The lower basin has about 40 percent of the dryland agriculture in the state as compared with only 2.4 percent of the total state dryland farming in the upper basin.

TABLE 15

LIVESTOCK AND CROPS CASH RECEIPTS
IN THE UPPER MISSOURI RIVER BASIN[1]
(Thousands of Dollars)

Year	Livestock Receipts	State Total	Percent of State Total	Crop Receipts	State Total	Percent of State Total
1986	$119,700	$838,353	14.3%	$37,385	$493,015	7.6%
1985	$124,522	$902,859	13.8%	$42,639	$422,444	10.1%
1984	$114,022	$844,683	13.5%	$34,684	$653,780	5.3%
1983	$ 98,651	$731,537	13.5%	$44,893	$846,939	5.3%
1982	$ 88,667	$724,805	12.2%	$60,714	$980,328	6.2%
1981	$ 86,218	$705,528	12.2%	$53,007	$854,196	6.2%
1980	$ 98,470	$828,880	11.9%	$41,102	$660,450	6.2%
Average	$104,321	$796,663	13.1%	$44,918	$701,593	6.4%

Source: Montana Crop and Livestock Reporting Service.

1 Includes Beaverhead, Broadwater, Gallatin, Jefferson, and Madison counties.

TABLE 16

LIVESTOCK AND CROPS CASH RECEIPTS
IN THE LOWER MISSOURI RIVER BASIN[1]
(Thousands of Dollars)

Year	Livestock Receipts	State Total	Percent of State Total	Crop Receipts	State Total	Percent of State Total
1986	$241,741	$838,353	28.8%	$184,082	$493,015	37.3%
1985	$272,147	$902,859	30.1%	$136,036	$422,444	32.2%
1984	$248,880	$844,683	29.5%	$252,933	$653,780	38.7%
1983	$215,725	$731,537	29.5%	$328,134	$846,939	38.7%
1982	$228,313	$724,805	31.5%	$355,893	$980,328	36.3%
1981	$222,745	$705,528	31.6%	$311,016	$854,196	36.4%
1980	$261,051	$828,880	31.5%	$240,195	$660,450	36.4%
Average	$241,515	$796,663	30.3%	$258,327	$701,593	36.8%

Source: Montana Crop and Livestock Reporting Service.

1 Includes Cascade, Chouteau, Fergus, Glacier, Judith Basin, Lewis and Clark, Meagher, Phillips, Pondera, Teton, Toole, Petroleum, Wheatland, Golden Valley, Musselshell, and Garfield counties.

TABLE 17

IRRIGATED AND NON-IRRIGATED LAND IN UPPER MISSOURI RIVER BASIN[1]

Year	Upper Missouri River Basin Irrigated	State Total	Percent of State Total	Upper Missouri River Basin Non-irrigated	State Total	Percent of State Total
1987	360,770	1,618,500	22.3%	201,400	7,623,000	2.6%
1986	344,470	1,601,000	21.5%	175,000	7,814,200	2.2%
1985	428,830	1,635,200	26.2%	171,500	5,977,500	2.8%
1984	481,300	1,805,600	26.7%	164,400	7,377,400	2.2%
1983	395,700	1,538,900	25.7%	220,700	7,151,400	3.1%
1982	417,850	1,729,900	24.1%	155,400	7,926,200	2.0%
1981	426,350	1,733,300	24.6%	144,000	7,932,600	1.8%
Average	407,896	1,666,057	24.5%	176,057	7,400,329	2.4%

Source: Montana Crop and Livestock Reporting Service.

Note: Includes Beaverhead, Broadwater, Gallatin, Jefferson, and Madison counties.

TABLE 18

IRRIGATED AND NON-IRRIGATED LAND IN LOWER MISSOURI RIVER BASIN[1]

Year	Lower Missouri River Basin Irrigated	State Total	Percent of State Total	Lower Missouri River Basin Non-irrigated	State Total	Percent of State Total
1987	410,150	1,618,500	25.3%	3,121,000	7,623,000	40.9%
1986	429,280	1,601,000	26.8%	3,207,900	7,814,200	41.1%
1985	382,500	1,635,200	23.4%	2,367,800	5,977,500	39.6%
1984	462,700	1,805,600	25.6%	3,141,500	7,377,400	42.6%
1983	405,400	1,538,900	26.3%	2,959,100	7,151,400	41.4%
1982	460,400	1,729,900	26.6%	3,105,100	7,926,200	39.2%
1981	426,800	1,733,300	24.6%	3,097,100	7,982,600	38.8%
Average	425,319	1,666,057	25.5%	2,999,929	7,407,471	40.5%

Source: Montana Crop and Livestock Reporting Service.

1 Includes Cascade, Chouteau, Fergus, Glacier, Judith Basin, Lewis and Clark, Meagher, Phillips, Pondera, Teton, Toole, Petroleum, Wheatland, Golden Valley, Musselshell, and Garfield counties.

Instream water reservations would not affect existing agricultural use in the basin, nor would they preclude the use of groundwater or water stored in offstream reservoirs for the development of additional irrigation. Reservations could limit future expansion of irrigated agriculture if new surface water sources are needed. However, even the maximum potential cost of the DFWP Reservation to new irrigated crop acreage in the upper Missouri Basin would be relatively small. Sanders (1989) provided a higher estimate for the number of existing irrigated acres in the upper basin (622,250 acres) than is displayed in Table 18 (407,896 acres). As of March 24, 1989, the Jefferson Valley, Broadwater and Gallatin Conservation Districts had submitted reservation requests for the irrigation of 23,925 additional acres by surface water upstream from Canyon Ferry Reservoir (Op.Cit.). If no other reservation applications for agricultural surface water diversions are submitted by other upper basin Conservation Districts, the maximum opportunity for growth in irrigated agriculture in the upper basin would essentially be limited to a 3.6% to 5.9% increase over existing acres. The maximum potential cost that the DFWP reservation could have upon agriculture above Canyon Ferry would, therefore, be to inhibit this relatively small increase in total irrigated crop acreage.

In the lower Missouri Basin, irrigated acreage estimates by Sanders (425,319 acres) were also higher than those in Table 18 (334,250). As of March 24, 1989, information was not available regarding reservation requests by Conservation Districts in the lower basin. The Montana Department of Natural Resources and Conservation (DNRC) is currently compiling these figures, while refining estimates of existing and potentially irrigable lands throughout the basin.

III. Effects of Not Granting the Reservation

A. Loss of Irretrievable Resources and Economic Opportunity

Not granting the DFWP reservation would cause irreplaceable losses to the wide-spread benefits associated with the protection of adequate instream flows in the Missouri Basin. Incremental stream flow depletions would continue to reduce critical components of the natural environment, including fish, wildlife riparian areas and water quality. This, in turn, would reduce the recreational activities supported by these resources, including fishing, floating, hunting and sight-seeing. The human environment would be similarly impacted through loss of scenic values and diminution of the basin's cultural, historical and social environment.

Long-term economic costs would be significant if instream flow depletions were to continue in the Missouri Basin. The brunt of these losses would be borne by stream flow-dependent recreational businesses and the cities and towns that receive the benefits of these sustainable enterprizes. However, since the recreational and scenic attributes that attract people to the basin would also diminish, these municipalities would also sustain other economic opportunity losses, i.e being less attractive to distance-independent companies, tourists and new potential residents with independent incomes. Service sector jobs would also be impacted. Not granting the DFWP flow reservation would, in essence, preclude a unique opportunity to support and protect collectively, the public interest, the environment and business interests. Denial of the reservation would be particularly incongruous at a time when the newly established "bed-tax" is just beginning to fund multi-million dollar, nation-wide advertising campaigns for recreational and service sector businesses, and local economic development organizations like the Gallatin Development Corporation are just beginning to attract new kinds of businesses to the Missouri Basin.

Without instream protection, other significant benefits to municipalities, agriculture and industry would also be diminished. New consumptive uses of water would continue to reduce downstream water availability and hydropower production. The recharge of stream-side aquifers, the assimilative capacity of streams and the viability of riparian ecosystems and sub-irrigated croplands would be diminished. Industrial and municipal waste treatment costs could increase. The potential for contamination of public drinking water by hazardous chemicals would become more likely, as would additional impacts to streams receiving abandoned mining discharges. Water disputes between consumptive users would worsen as water availability at headgates declines. The effects of not granting the reservation would, therefore, be cumulative, and in many cases irretrievable, to a broad spectrum of resources and water users in the Missouri Basin.

B. Alternative Actions That Could Be Taken If the Reservation is Not Granted

1. No Action

A no action alternative regarding water reservations in the Missouri Basin would result in the same costs to recreation, fish and wildlife, economics, aesthetic qualities and other public amenities that were just described in the Effects of Not Granting the Reservation. Other alternative actions that could reasonably be taken to protect these amenities and economic assets are described below. With the possible exception of 2, these alternatives either are more costly, would be less immediate, lack legislative mandates and/or would be more limited in applicability, than would implementing the DFWP reservation as requested in this application.

2. Intensification of Water Conservation and Management Practices

Examples of water conservation practices include better maintenance and lining of ditches, converting irrigation projects from flood to sprinkler systems, limiting the use of sprinklers during windy periods and of course, only diverting the amount of water actually needed for proper crop production. The latter involves installation and/or better management of water diversion and delivery systems, including improved operation and use of headgates and flumes to accurately measure water delivered to users; better information and education about water needs for specific crops throughout the basin's widely varying soil, climatic and topographic conditions; better irrigation scheduling; and increased utilization of water commissioners.

Proper water conservation and management practices not only enhance water efficiency, they also reduce soil erosion by preventing overland (sheet) runoff from croplands and minimizing volumes of silt-laden irrigation return flows. As such, application of the above measures should be encouraged regardless of any other legal directions elected during this reservation process.

Although unquestionably worthwhile and necessary, good water conservation and management practices do not represent a viable alternative to reserving instream flows. In many instances, any water conserved, and thus left instream, may simply be diverted by other offstream users. Even if the state were to offer to pay for the infrastructure necessary to improve efficiency in agricultural water use, which in turn would reduce offstream diversion rates and theoretically increase instream flow levels, there is presently no legal method for a public agency to claim or protect water acquired in this manner. This same legal obstacle is also a deterrent to the buying or leasing of water rights.

3. Buying or Leasing of Water Rights

A state agency's ability to protect instream water rights that have been converted from offstream rights through leases, gifts, purchases or improved conservation measures has been severely hampered by a recent court decision involving a water right claim for Bean Lake. The lower court ruled that the pre-1973 claim by the DFWP for instream use was invalid because the agency never diverted or impounded the water, never demonstrated an intent to claim the water right or gave notice to other water users of that intent. The State Supreme Court recently upheld the lower court's ruling. Unless the legislature removes the diversion requirement for claiming instream water rights, the leasing or buying of water is not a valid alternative to the reservation of instream flows.

This is particularly unfortunate for streams where present water users would be willing to lease their offstream rights as part of a water conservation program. For example, water users would receive annual lease payments and farm their lands as usual except during low water years. Then, in accordance with lease agreements, normally-diverted water would be left instream. The annual lease payments would provide compensation to landowners for irrigated crop damage suffered during the low flow years. Actual crop loss could also be reduced if the landowners planted non-irrigated crops on the leased land following years when snowpack is low enough to curtail normal irrigation practices.

Even if, or when, legal obstacles for protecting transferred water rights are removed, the buying or leasing of water would still not be a viable, basin-wide approach for enhancing instream flows. The administration and logistics of such an extensive program would be exceedingly complex, and the cost to the public would be high. This alternative might, however, be best applied in drainages that are severely dewatered, where present offstream users are willing to sell or lease their rights and where water adjudication proceedings have been completed. The later condition is very important, since it would be difficult to accurately transfer water rights without precise knowledge of water use and availability in a given drainage.

4. Constructing Offstream Water Storage Facilities

The construction of offstream reservoirs that would store runoff waters and release them during summer is an often overrated alternative for enhancing instream flows. Construction, operation and maintenance costs are usually prohibitive, unless cooperatively undertaken with offstream users. Even then, there is considerable uncertainty about agreed-upon releases ever reaching critical downstream reaches.

The problems associated with protecting transferred water rights, as was just discussed for buying, leasing or conserving water, also apply to water that is "owned" because of participation (cost-sharing) in the development of multipurpose storage facilities. The water release arrangement for Painted Rocks Reservoir exemplifies these problems.

Located in the headwaters of the Bitterroot River, this state-owned facility was originally constructed for irrigation use. Since part of this offstream use has never materialized, the DFWP has routinely purchased water to be delivered to chronically dewatered reaches of the river. However, until a water commissioner was appointed by the court in the late 1980s, most of this purchased water was diverted for offstream use before reaching the Bell Crossing area near Hamilton.

The usefulness of reservoir storage may also be limited by the hydrogeology of a drainage. The case of the proposed irrigation/recreation reservoir on the Little Boulder River illustrates this point. During the environmental analysis of this proposal, it was found that the thick, unconsolidated gravels of the Boulder Valley cause the river to be a "losing stream," i.e. in most reaches it looses more surface water than it normally receives as recharge during summer, low-flow conditions. Much of the water released from this proposed reservoir would have, therefore, recharged the valley's groundwater instead of augmenting instream flows. Similar hydrogeologic conditions undoubtedly occur in other drainages of the Missouri Basin. In these drainages, counting on reservoirs to supplement surface streamflows during summer would not be a wise investment.

Reservoirs often create other environmental costs, including:

1) detrimental effects to cold water fisheries resulting from increased temperatures of stored waters;

2) detrimental effects to stability and diversity of stream channels and riparian areas because of reduced frequencies and intervals of flushing flow discharges; and

3) increased depletion of surface water because of increased evaporation rates; these depletions also cause

concentrations of dissolved solids (salinity) and other contaminants like nutrients and pesticides to increase within reservoirs.

5. Revising the Process for Conditioning Water Rights Permits

For water use applications or transfer of water rights exceeding 4,000 acre-feet per year and 5.5 cfs, MCA 85-2-311 (2)(c) requires that certain "public interest" and "reasonable use" criteria be met before approval to divert the water is granted. Criteria to be evaluated include demands on future water supply; needs to preserve instream flows; benefits to the applicant and the state; effects on water quality, including the potential for creating saline seep; the feasibility of using other (low-quality) water; and consideration of other adverse environmental impacts.

Although the above "conditioning" of water use permits would certainly be helpful for protecting instream flows from large offstream diversions, it does not represent a widely applicable alternative to the water reservation process. Applications for water use that are large enough to trigger utilization of the above criteria are very uncommon. In fact, 80% of all water use permits issued by the DNRC since July 1973 have been for quantities less than 1.0 cfs.

To be an effective component of an instream protection strategy, the conditioning of water use permits must, therefore, be revised to include the review of much smaller requests.

Instead of an arbitrary volume figure, conditions triggering the use of public interest/reasonable use criteria should instead be guided by the effects of an application upon a given stream's available flow and upon the cumulative basin-wide impacts of all future water appropriations. Unfortunately, there are few streams in the basin that have enough stream gauging data to document existing available flows. Nor have enough streams in the basin been adjudicated, which makes documentation of existing use extremely difficult.

Finally, even if conditioning of permits were to be revised to incorporate some smaller "triggering criteria," this alternative should only be considered as a supplement to the protection of instream flows through water reservations. Unless conditioning criteria were to be applied to <u>every</u> water use application in the Missouri Basin (an unlikely situation in the foreseeable future), many "small" water use permits, those still not surpassing the revised criteria, could continue to be granted without adequate consideration of immediate and cumulative effects upon fish and wildlife uses.

6. Closing Basins

Montana water law at MCA 85-2-319 states that the DNRC "may by rule reject permit applications or modify or condition permits issued in a highly appropriated basin or sub-basin," but "only upon a petition signed by at least 25% or 10, whichever is less" of present water users in the basin or sub-basin. The petition must allege that throughout or during certain times of the year there are no unappropriated waters in the basin; the rights of present users will be adversely affected; or further uses will interfere unreasonably with other already permitted uses, or uses for which water has been reserved. Upon receiving a petition, the DNRC must either deny it, or if needed, conduct a water availability study and initiate rule-making proceedings.

A petition to close the Musselshell River Basin has been submitted to the DNRC by the Deadman's Basin Water Users Association. A water availability study is being conducted, and a predictive model is being developed, to better examine the concerns raised in the petition and to determine if rule-making proceedings will be necessary.

On March 30, 1983, the DNRC closed the Milk River mainstem to any further applications "for direct diversion without storage of waters . . . for irrigation or any other consumptive use." The department acted to close the river (except for some reaches during runoff periods), pursuant to MCA 85-2-321, a legislatively-mandated water availability study and rule making procedure directed specifically at the Milk River Basin.

Both the Musselshell and Milk River proceedings occurred because of concerns raised by existing offstream water users in already "highly appropriated" basins. These is no opportunity in Montana water law for the general public or state agencies to initiate action to close basins because of instream flow concerns (thereby preventing the over-appropriated conditions occurring in the above basins). By the time closures are being considered, there may not be water available for instream flow needs. As such, this procedure is not a viable alternative to the timely implementation of instream flow reservations.

7. Application of the Public Trust Doctrine

The Montana Supreme Court applied the public trust doctrine in two 1984 decisions involving the public's right to use water courses for fishing and floating. The court held that "under the public trust doctrine and the Montana Constitution, any surface waters that are capable of recreational use may be so used by the public without regard to streambed ownership or navigability for non-recreational purposes." In an attempt to provide management policies that address and implement these court decisions, the 1985 Montana Legislature passed the "Stream Access" bill. The provision in the Montana Constitution specifying that all waters of the state "are the property of the state for the use of its people," was an important factor guiding the court decisions and the subsequent legislation. In 1987 the court further overruled an appeal by landowners that the above actions represented an unconstitutional taking of private property without just compensation. In this latter decision, however, the court did appear to limit the application of the public trust doctrine to recreational water use in Montana.

The limits to, and effectiveness of, the public trust doctrine for protecting instream flows in Montana remains largely untested. As an absolute protection strategy, it should probably be considered only as an alternative of last resort. Hopefully, the spirit and intent of the doctrine will guide and direct the final decision for an adequate amount of instream flow protection for fish, wildlife and recreation in the Missouri River Basin.

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